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FINAL REPORT

ON THE

GEOLOGY AND MINERALOGY

OF THE

STATE OF NEW HAMPSHIRE;

WITH CONTRIBUTIONS TOWARDS THE

IMPROVEMENT OF AGRICULTURE

AND

METALLURGY.

BY CHARLES T. JACKSON, M. D.

Published by order of the Legislature.

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1844.

LAWS OF THE LEGISLATURE OF NEW HAMPSHIRE, AUTHORIZING THE MINERALOGICAL AND GEOLOGICAL SURVEY OF THE STATE.

At the session of the Legislature, June, 1839, the following law, providing for the Geological and Mineralogical Survey of the State of New Hampshire, was passed:

AN ACT to provide for the Geological and Mineralogical Survey of the State.

SECTION 1. *Be it enacted by the Senate and House of Representatives in General Court convened,* That the Governor of this State is hereby authorized and required, as soon as may be after the passage of this act, to appoint a State Geologist, who shall be a person of competent scientific and practical knowledge of the sciences of geology and mineralogy; and the said State Geologist shall, by and with the consent of the Governor and Council, appoint one suitable person to assist him in the discharge of his duties, who shall be a skillful analytical and experimental chemist.

SEC. 2. *And be it further enacted,* That it shall be the duty of the said State Geologist and his said assistant, as soon as may be practicable after their appointment, to commence and carry on, with as much expedition and despatch as may be consistent with minuteness and accuracy, a thorough geological and mineralogical survey of this State, with a view to determine the order, succession, arrangement, relative position, dip or inclination, and comparative magnitude of the several strata or geological formations within this State, and to discover and examine all beds or deposits of ore, coal, clay, marls, and such other mineral substances as may be useful or valuable, and to perform such other duties as may be necessary to make a full and complete geological and mineralogical survey of the State.

SEC. 3. *And be it further enacted,* That it shall be the duty of the said assistant, to make full and complete examinations, assays and analyses of all such rocks, ores, soils or other substances as may be submitted to him by the State Geologist for that purpose; and to furnish him with a detailed and complete account of the results so obtained.

SEC. 4. *And be it further enacted,* That it shall be the duty of the said State Geologist, on or before the first day of June in each and every year during the time necessarily occupied by said survey, to make an annual report of the progress of said survey, accompanied with such maps, drawings and specimens as may be necessary and proper to exemplify and elucidate the same, to the Secretary of the State, who shall lay such report before the Legislature.

SEC. 5. *And be it further enacted,* That it shall be the duty of the said State Geologist to cause to be represented on the map of the State, by colors and other appropriate means, the various areas occupied by the different geological formations in the State, and

to mark thereon the localities of the respective beds or deposites of the various mineral substances discovered, and on the completion of the survey, to compile a memoir of the geology and mineralogy of the State, comprising a complete account of the leading subjects and discoveries which have been embraced in the survey.

Sec. 6. *And be it further enacted*, That it shall also be the duty of the said State Geologist to forward to the Secretary of the State, from time to time during the progress of such survey, such specimens of the rocks, ores, coals, soils, fossils and other mineral substances, discovered and examined, as may be proper and necessary to form a complete cabinet collection of specimens of geology and mineralogy of the State; and the said Secretary shall cause the same to be deposited in proper order in some convenient room in the State Capitol, there to be preserved for public inspection.

Sec. 7. *And be it further enacted*, That for the purpose of carrying into effect the provisions of this act, the sum of two thousand dollars is hereby annually appropriated for the term of three years, to be expended under the direction of the Governor:—*Provided, however*, that the salaries of the said State Geologist and his assistant shall not commence until they shall have entered upon the execution of their duties; and upon the completion of said survey and of the duties connected therewith, they shall wholly cease and determine.

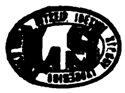
MOSES NORRIS, Jr., Speaker of the House of Representatives.
JAMES M'K. WILKINS, President of the Senate.

Approved June 24, 1839.

JOHN PAGE, Governor.

In pursuance of the foregoing law, Charles T. Jackson of Boston, Mass., was appointed State Geologist, and received the following commission:

STATE OF NEW HAMPSHIRE.



To Charles T. Jackson of Boston, in the county of Suffolk and Commonwealth of Massachusetts, Esquire: Greeting.

Know you that I, John Page, Governor of the State aforesaid, do by virtue of authority vested in me, hereby constitute and appoint you, the said Charles T. Jackson, State Geologist for said State of New Hampshire, agreeable to an act, entitled "An act to provide for a Geological and Mineralogical Survey of the State," approved June 24, 1839. You are, therefore, hereby vested with all the power and authority, and entitled to all the privileges appertaining to a geologist for said State, under the provisions of said act.

Given under my hand and the seal of said State, this tenth day of September, in the year of our Lord one thousand eight hundred and thirty-nine.

JOHN PAGE.

By His Excellency the Governor—

JOSIAH STEVENS, Jr., Secretary of State.

The State Geologist, by consent of the Governor and Council, appointed the following gentlemen as his assistants, who successively performed the services required of them:

J. D. Whitney was appointed Dec. 7, 1840, and served in the Laboratory during the winter. M. B. Williams was appointed in June, 1841, and served during the summer of

that year. W. F. Channing was appointed June 7, 1842, and served in the summer of the same year. Eben Baker served in the autumn and winter of 1842. John Chandler served in the winter of 1843, in the laboratory.

Resolve of the Legislature passed June, 1842, to continue the Survey:

Resolved by the Senate and House of Representatives in General Court convened, That the sum of three thousand dollars be and hereby is appropriated to continue the geological and mineralogical survey of the State, and that His Excellency, the Governor, be authorized to draw from the treasury, by warrant, as the same may be required.

Approved June 23, 1842.

Resolves of the Legislature passed June, 1843, for printing the final Report of the State Geologist:

Resolved by the Senate and House of Representatives in General Court convened, That the Secretary of State procure the printing of six hundred copies of the final Report of the Geological and Mineralogical Survey of this State, with the maps, plates and sections; and that the necessary maps, plates and sections be paid for from any money in the treasury not otherwise appropriated, and that the Governor, with the advice of Council, shall examine and decide what plates, maps and sections are necessary, and the Governor shall draw his warrant on the treasury for so much money as may be necessary therefor.

Resolved, That five hundred copies be printed of the Geological Report, to be had on sale at the same price as those furnished for the State, provided they are subscribed for before their publication.

Approved, July 1, 1843.

Resolve of the Legislature, passed June, 1843, discontinuing the Survey and services of the State Geologist:

Resolved by the Senate and House of Representatives in General Court convened, That the Geological Survey of this State be no farther prosecuted, and the services of the State Geologist be dispensed with, except so far as may be necessary to complete the printing of his final Report.

Approved, July 1, 1843.

Appointment of Engraver.

On the 5th of August, 1843, Charles Cook of Boston, Mass., was appointed Engraver, of whose appointment the following record is copied from the books of the Governor and Council:

State of New Hampshire, Executive Department, Aug. 5, 1843.

Upon the recommendation of Doct. Charles T. Jackson, Mr. Charles Cook of Boston, has been appointed the engraver, to engrave the maps, plates, sections, &c., ordered to be engraved for the use of the State, and which are to be printed in connection with the Report of the Geological Survey of the State, about to be published under the direction of the State Geologist.

INTRODUCTORY LETTER TO THE GOVERNOR.

To His Excellency, JOHN H. STEELE, *Governor of New Hampshire:*

Sir:—I have the honor of laying before your Excellency my Final Report on the Geological and Mineralogical Survey of the State, made in accordance with the provisions of the Legislature, as stated in the foregoing copies of the laws in relation to it. In addition to this service, I have contributed some information applicable to the improvement of agriculture and metallurgy, which I hope may prove useful. The report is illustrated by numerous wood engravings, and some excellent lithographic views of remarkable scenery, and an improved map of the State, on which the geological formations and most important minerals are designated. Also two plates, containing eight sectional profiles of the rocks of the State, colored according to the principles of the science; which also represent the topographical features of the country on a determinate scale.* The execution of the lithography is highly creditable to the skill of Mr. Charles Cook, who was charged with the work, and who has completed his contract in a faithful manner.

Although there is much still remaining to be done to complete a full account of the geological and mineralogical resources of the State, a few towns not having been explored, for want of time; still I hope enough is presented in this Report, to satisfy the government and the people, that every possible exertion has been made by the geologist and his assistants, to make the survey as thorough as could be done in the limited time allowed by law. If, therefore, any dissatisfaction should be expressed on account of our not visiting every town and farm, the omission should not be attributed to any negligence on our part, but to the expiration of the time allowed by law for the field operations. I do not apprehend, however, that any reasonable men will find fault with us on this account; and if the nature of the work is considered, they will find it as complete as could have been expected in a survey of only three years' duration. I trust that men of enlarged views, will find that the expenditure of a small sum for the exploration of the country has proved a good investment, and one which, by the constitution of the State, the legislature was expected to appropriate for the general good. The Report which I now offer is confessedly imperfect, and I regret that circumstances beyond my control have prevented my making it more worthy of the subject.

In a geological survey it would be absurd to run in a confused manner over the towns; for no useful or systematic results could be attained by so doing; nor is it necessary to go into every village, where it is perfectly obvious from the course of barren rocks already examined, that they run directly through it, and form its entire substrata. A systematic method is required, and was followed with as much fidelity as possible, in the course of the survey of New Hampshire; the only deviations from it being at the request of individuals who were desirous we should visit some localities of supposed importance, or to examine a peat bog or farm. If there are repetitions, it must be remembered that the rocks are

* In the Agricultural department I have presented a drawing of the appearance of seeds when tested by chemical solution, so as to indicate the nature and extent of the principles which they contain. This plate is printed by lithography, in colors—a new art.

repeated many times, and to be true to the science, the language must necessarily be repeated also in detailing the geology of the different localities.

Much unwritten agricultural information has been scattered broadcast in our travels, and if more abundant harvests should spring up therefrom, it will afford me great satisfaction to have been instrumental in advancing the most important of the arts.

Advice has been freely given to all who sought for information respecting mines and minerals. Useless expenditure of time and money has been prevented by timely suggestions. Delusions respecting mineral rods, gold, silver and coal mines, have been dispelled, and a sane view of the science of mining has been earnestly inculcated. The extent of errors, of the kind alluded to, has not been fully exposed to the public in this Report, and could not be, without violating that confidence which has been placed in me. Erroneous notions have been corrected, without exposing the names of the individuals who have labored under them. The propriety of this course will be understood and appreciated.

I have advised no man to engage in mining enterprises, unless he was acquainted with the business, and had spare capital to invest, and was willing to risk something in the work. In general, I have recommended to those who chanced to have valuable mines on their land, to sell the right of mining at a reasonable rate, to persons who would be most likely to embark in a mining enterprise, and not to idle speculators.

A wholesome and honorable enterprize in mining should meet with encouragement from government, and every lawful facility should be granted to the manufacturer, who converts materials, naturally worthless, into valuable products. The manufacture of glass and iron are both familiar examples of the kind of productive industry to which I allude, and the people of New Hampshire would severely feel the loss, if even the few manufactories of the kind now in the State should be discontinued. There are other branches of art not yet cultivated, which, if established, will be advantageous to the people, and all proper inducements should be offered to encourage the enterprize of the miner and manufacturer. The cheapness of wood fuel is an important consideration to the manufacturer, who may contemplate the erection of glass works, and iron, copper and zinc smelting furnaces in New Hampshire; and the raw materials required for such works are sufficiently abundant to warrant their being wrought.

There are extensive veins of iron ore where the smoke of a furnace has not yet been seen, and if the working of a vein only four feet wide has resulted in the building up, in a wilderness, of the prosperous village of Franconia, how much more may be expected from the manufacture of iron from some of the extensive veins, described in this Report as occurring in Piermont and Bartlett!

It has been proved by experiment, as it was foreseen in theory, that the iron ore of Bartlett may be converted directly into a coarse cast steel, and by more refined process may be made into the finest kinds, the ore being specially adapted to that manufacture, since it contains the requisite quantity of manganese.

Zinc has never been manufactured from blende, on a large scale, in this country, but from my researches, it is proved that it can be obtained in larger proportions from the Eaton blende, than from that wrought in Bristol, in England. Extensive veins of this ore are found in Eaton and Warren, and smaller ones in Shelburne and Lyman.

Copper may be wrought in Warren, and perhaps in Bath, but the latter locality has not been fully explored.

Tin ore has been discovered in Jackson, in sufficient quantities to repay the expense of its extraction; but it is not sufficiently abundant to supply a furnace, though it is not improbable that more will be found by mining, and by search in other places.

For a full account of the minerals and rocks of economical importance, I beg leave to refer to the subsequent pages, where each locality will be described.

Acknowledging the kind attentions which have been offered to me and my assistants in all parts of the State, and expressing my thanks to the citizens of New Hampshire for the same,

I have the honor to be,

Most respectfully,

Your Excellency's ob't serv't,

CHARLES T. JACKSON.

Boston, June, 1844.

PRELIMINARY REMARKS.

In offering this final report on the Geological and Mineralogical Survey of New Hampshire, a few observations on the utility of such explorations may not be inappropriate.

Those who are familiar with the science and the history of such operations, are already fully aware of the importance of Geology, Mineralogy and Chemistry in the advancement of the arts of civilization. Many individuals who have paid but little attention to modern improvements, are not sufficiently aware of the applications of scientific principles to the arts, and are unacquainted with the nature of Geological researches. It, therefore, may be useful to point out a few of the most important facts and principles of the science, before entering into the details of this Report.

Geology signifies a description of the earth. Its objects are the investigation and description of the structure of the globe, the nature of its various components, and the laws which have effected and still continue to produce changes in its mass. It addresses itself both to the philosopher and to the practical man. To the former it rationally explains the laws which have governed the world during its different epochs of creation, while to the latter it serves as the best guide in discovering the various mineral ingredients which occur in the earth.

Connected so intimately with the great interests of mankind, it has not failed to attract the most earnest attention in all parts of the civilized globe, and it has been justly remarked that a correct scale of the intelligence and prosperity of nations could be formed by observing the relative degrees in which they cultivated Geology.

It is gratifying, therefore, to perceive that the American people have not been found behind the age, as will appear from the fact that not less than twenty two among our twenty six States have made, or are making Geological Surveys, under laws enacted by their representatives.

Anterior to these surveys there prevailed many erroneous opinions concerning the nature and situation of minerals, and numerous absurd speculations may be traced directly to a want of knowledge of the principles of mineralogical and geological science.

Thus, iron pyrites would not be mistaken for gold, brass, silver, or tin; nor the shining particles of yellow mica be regarded as a precious metal, were the people acquainted with mineralogy or chemistry. Coal would not be regarded as indicated by black tourmaline, or sought for in primary rocks, if a general knowledge of the first principles of geology prevailed.

It is obvious, then, that State geological surveys evince a wise economy on the part of the legislatures who have authorized them; for the cost is but trifling when the work is carried on under the patronage of the government, while the information obtained belongs to the whole people.

Apart from the advantages arising from the correction of erroneous opinions and the stopping of unwarrantable mining operations, we ought to consider how much useful information both of a scientific and practical nature is diffused among the people by the publication and distribution of the various geological reports. In them will be found the most authentic information concerning the structure and mineral wealth of the country; so that all who are disposed to learn geology or mineralogy as sciences, or to engage in the practical operations of mining, quarrying, or in the cultivation of the soil, may find the most detailed descriptions of each geological district.

By an interchange of their reports, the different States may be enabled to enrich their libraries with valuable books, by which the people may have an opportunity of comparing the resources of different sections of the United States, and avoid much loss of labor, time and trouble in traveling abroad to discover for themselves advantageous locations for settlement or mining enterprizes. The State Geologists have no other objects in view than the full and impartial description of their several States, and their opinions on any subject of importance, concerning mines and minerals, ought to be regarded a sconclusive in all cases, where they have had a fair opportunity of making explorations.

Agriculture is much indebted to geologists and chemists for their contributions towards the natural history, composition and new methods of improvement of soils. Wherever attention has been paid to their advice, the farmers have not failed to gain useful instructions and suggestions, and it is very rarely the case that they spurn scientific opinions. This I may truly say of those with whom it has been my lot to sojourn during the past nine years. Only the ignorant venture to distrust the researches of scientific observers.

Observing and reflecting men always are ready to improve their practice by all the new light that they can obtain, and know that since nature operates by certain laws, they may acquire useful information from those who have had opportunities for accurate investigations.

Superposition and Intrusion of Rocks.

Regarding gneiss as our geognistic horizon, we may classify the other rocks as they were deposited upon it or protruded from below, through it and the superincumbent strata.

The deposited strata may be called epigene, and the intrusive rocks, or those that were protruded from below, hypogene.

The epigene rocks are all more or less distinctly stratified, and were deposited from water which originally held the particles in suspension or solution. The first deposits contain few, if any, remains of organized beings, either animal or vegetable. If any were originally contained in those rocks, their forms have been obliterated by the agency of heat, originating from the nether rocks.

Thus, mica slate contains no other traces of organic matter than plumbago, which may have been formed from vegetable substances and limestone, which many geologists regard as having been derived from marine shells and corals. When the limestone is crystaline, as is generally the case in New Hampshire, it is supposed that the sedementary deposit, subsequent to its deposition, underwent a change in structure by the agency of heat.

This theory is maintained by analogy between the conditions observed in other sedimentary limestones altered by fire, and the fossiliferous rocks from which they were formed. Numerous examples of such a metamorphosis may be seen in the adjacent States of Maine and Vermont, where fossiliferous limestones are observed to change into the crystaline or saccharoidal variety, when they approach rocks of igneous origin, every shade of passage from one variety to the other being distinctly recognized by the observer. Dufrenoy, Elie, De Beaumont and Von Buch, have noticed such metamorphoses in numerous places in Europe. The celebrated Carrara marble, so remarkable for its crystaline structure as to have been taken for a type of a primary limestone, has been distinctly proved to have originated from a secondary limestone belonging to the oolite group. The crystaline white marbles of the western fllank of the Green Mountain range in Vermont, evidently belong to the same group with the secondary fossiliferous limestones bordering Lake Champlain, the passage from the one to the other being easily traced.

So, likewise, we can show that the secondary limestones belonging to the red sandstone of Machias, Me., have undergone a change in the neighbourhood and in contact with the igneous rocks which occur there, and the fossils have been obliterated and the rock converted into a granular or crystaline white limestone.

The foregoing remarks will explain what is meant by metamorphic rocks, so far as relates to the limestones; but there are many other varieties of metamorphism which require to be noticed.

When clay slate rocks come in contact or near igneous rocks they undergo remarkable changes, the slate generally becoming much more hard, compact and sonorous. Sometimes it is converted into micaceous or talcose slate, and very frequently is charged with crystals of iron pyrites. Specular iron ore also occurs in the fissures and between the laminae.

The slate rocks are often changed in color by contact with igneous rocks becoming white, blue or red, according to the degree of heat to which they have been subjected and the metallic oxides they contain.

If the slate contains lime the rock becomes a kind of chert from the formation of silicate of lime by heat. When the strata have been broken up by the protruded rocks, the fragments of both rocks are frequently mingled together and cemented into a hard breccia consisting of angular fragments. When complete interfusion has taken place, a variety of porphyry or basanite is formed which is very hard and tough, or a kind of jasper is produced by the baking of the clay slate. Several beautiful striped and compact jaspers have been formed in this manner from stratified slate rocks, by the agency of large dykes of greenstone trap.

Sandstones acted upon by igneous rocks, are also changed in their characters; sometimes the rock is merely hardened and cracked from shrinkage; in other cases it is converted into porphyry, or if broken up into brecciated conglomerates, mixed with the intrusive rock, forming trap tuff, which occasionally contains masses of metallic copper bearing every appearance of having been melted.

Specular and magnetic oxide of iron veins and segregated masses of copper ores also are found in it. Galena is frequently found at the junction of trap rocks with limestones and slates.

Talcose and chlorite slate rocks appear generally to have been formed by the metamorphic changes of sedimentary matter, influenced, no doubt, by mineral waters derived from springs or from the ocean. The hornblende slate of New Hampshire is but a modification of micaceous slate, and the talcose slates appear to belong to the same group.

Having devoted a few pages to the consideration of metamorphic rocks, let us next examine the causes which have produced these changes.

Geology has revealed the interesting fact, that not far from the present surface of the earth and within its crust there prevails a much higher temperature than can be accounted for by the heat received from the solar rays.

Departing from a point where the mean temperature of the climate is marked, we find in descending into the earth that the heat augments in the ratio of 1° for every 50 feet as we descend, there being a difference in the rate of augmentation of temperature in different countries, owing to the relative thickness and conducting power of the rocks. Thus, in France the ratio of increase of heat is 1° in 40 feet, while in England it is 1° in 50, and in this country 1° in sixty or seventy feet. The mean will be, nearly as at first stated.

If, then, this augmentation of temperature takes place in a uniform manner, the depth at which water will boil, and that at which all metals and rocks will melt, can be calculated.

It is probable, however, that the ratio of increase of heat is much more rapid than has hitherto been estimated, and the fusing point of rocks is not so deep as was at one time supposed.

The result of experiment and calculation seems to prove that the interior of the earth is really a mass of melted matter, and the crust on which we live is very thin when compared with the bulk of the globe. Some have estimated that all rocks would be melted at the depth of sixty miles; others at a much less depth.

If this is true, as we have reason to believe it is, we can easily account for the phenomena of volcanic eruptions in modern times, and by the same kind of reasoning can extend back our view into times long past; and may be justified by analogical reasoning in regarding many of the rocks as the products of fiery fusion of the earth's crust, or as originating from the oxidation of the primitive elements of the rocks themselves. Allowing that there exists a sea of molten matter beneath the present crust of the globe, we may easily conceive that when by any tumultuous movement of that liquid mass the crust of the globe is cracked and opened, that the molten rocks should be protruded into the fissure, forming by this means dykes and veins in the superincumbent rocks. A line of elevation and fissuring of the strata will correspond to one epoch of upheaval, another to a separate one, and thus we may classify our mountain chains, dykes, veins and fractures, as readily as we are able to denote the order of superimposed strata.

Beaumont has thus beautifully generalized the elevation of mountain chains, and shown the epochs of each elevatory movement by the disturbance of the stratified deposits. Similar observations have been made in this country, coinciding with the views of the French geologist.

Not only have mountains been elevated by causes such as have been just mentioned, but a more general movement of uptilting and subsidence of the earth's crust has been

demonstrated, by which whole continents are slowly and imperceptibly raised or lowered by this "*mouvement de bascule*," or tilting of the crust of the globe. Although such movements do not appear sensible to present observers, yet in the immense periods of geological time they can be manifestly proved to have taken place, and there can be no doubt that they are still in progress. Where tide levels have been carefully marked for centuries, as is the case on the coast of the Baltic, or where ancient cities indicate the relative positions of dry land and the sea, these monuments record the gradual change of level to be in constant operation; more rapid, however, in some countries than others. If during the period of human observation and history, so marked a change as the elevation and subsidence of portions of the earth's crust can be demonstrated, may we not look back to the prodigious cycles of geological epochs for alterations more stupendous?

A modern volcano serves as a type on a small scale, by which we can represent the vast and mighty movements of the molten crust of the earth. Its dykes are keys by which we unlock the historical proofs of the origin of trap dykes, porphyry elvans, granite veins, and even the general fissuring and disruption of the crust of the globe. The same laws prevailed in former times as now, and though they have been impaired in energy, still they serve to illustrate the operations of nature's great laboratory, with its enormous furnaces and prodigious up-castings.

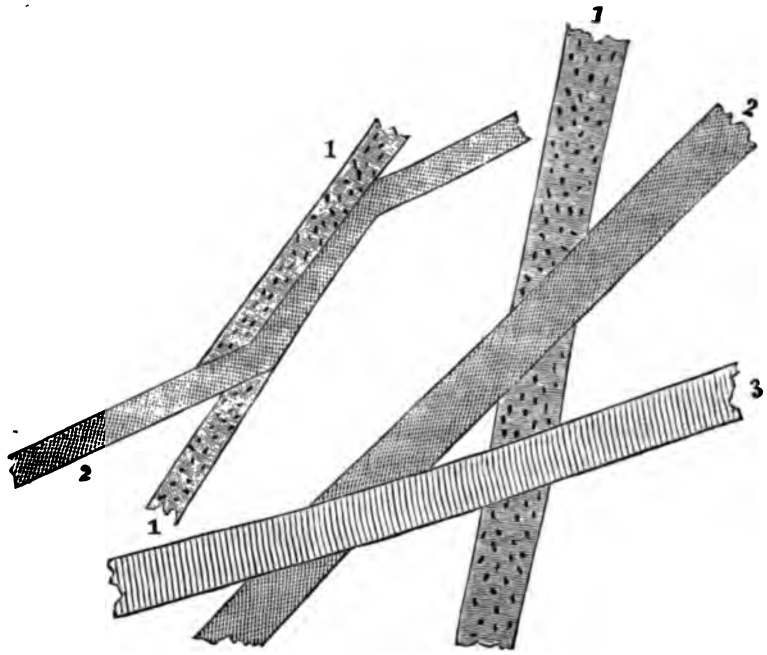
The relative ages of intrusive rocks which cut through the statified formations or through each other, may be mathematically demonstrated. Thus a dyke or vein, if it cuts through a sedimentry deposit, must have been thrown up subsequent to that deposition of matter, for it cuts through a fissure formed in it after its consolidation. Now if we can by the fossils or other marks determine the age of the sedimentary deposit, we have one point proved, for the dyke was formed subsequent to its deposition. Again, we may find a certain subsequent deposit through which the dyke did not penetrate, and which was not disturbed by it. Then we shall have fixed the limits and have proved that the dyke was thrown up subsequent to the first deposit, and anterior to the second.

Let us then find another dyke cutting across this, and we then know that it was elevated subsequent to it, for it could not have been cut off anterior to its existence, and the two could not have been synchronous in their elevation, as may be proved by other means, viz., by their both being quite distinct and exactly like two dykes of lava of different epochs of eruption.

Again, let a third dyke cut across both of the above and we have a proof of a still more recent eruption. Thus it is easy to fix the relative ages of erupted rocks, dykes and veins. The same law holds with regard to metalliferous ores which occur in veins and beds. Having observed the above mentioned facts, we can generalize on them so as to know in an instant the age of any dyke or vein, by noting the direction which it takes. We can also, by observing the mineralogical nature of rocks of each epoch of eruption, further confirm the results we have arrived at by the former examination.

In this manner the relative ages of each erupted rock in Maine was fixed with almost mathematical certainty, and the results obtained there have been confirmed by the exploration of the geology of New Hampshire.

The following diagram will best illustrate the above remarks. The figures indicate the relative ages of the three dykes or veins in their order of eruption.



We may enumerate the ages or relative times of eruption of rocks as follows :—

1st. Granite veins, several series of different ages.

2d. Sienite " " "

3d. Porphyry.

4th. Porphyritic trap.

5th. A bluish trap rock, very hard and compact.

6th. Brown trap rock and serpentine.

7th. Black trap rock.

8th. Basalt with olivine.

10th. Lava dykes of volcanoes now in action.

All but the last on the above list have been observed in New England.

In noting the directions of these dykes and veins it was remarked that the most ancient ran N. and S. while the most recent have an E. and W. course—the former corresponding to the elevation of our great primary mountain ranges, and the latter to modern volcanoes.

Stratified Rocks.

Stratified rocks are distinguished from the unstratified by their structure. They are made up of layers of mineral substances, arranged like sheets of paper placed one on another, and most, if not all, rocks of this structure appear to have been deposited from water

which originally held the particles in suspension or solution. Where the particles are large, it is supposed they were deposited by rapidly moving water, or have been transported from more elevated regions by torrents, freshets of rivers, or by powerful waves of translation.

The coarser sedimentary matters were evidently formed of large masses of rocks ground smooth by the long continued action of water, and by abrasion of their surfaces by attrition. In Roxbury, Massachusetts, and in Rhode Island, we see in the coarse conglomerate, abundant proofs of the action of the ocean surges, which ground and polished the stones which make up the principal components of that remarkable deposit, while the finer matter cementing the rounded stones, together was evidently derived from the finer particles rubbed off by the grinding of the larger masses against each other.

Sedimentary rocks, like slate and fine sandstone, evince the action of more tranquil waters, which slowly let fall the minutely divided matter which was washed into the sea by rivers. The degree of fineness of the particles is the scale by which we are enabled to judge of the slowness of their deposition, as we know the rate at which such matters are deposited by water. Now, if we consider the vast thickness of our sedimentary rocks of this character, they will serve to indicate the immense periods of time required for their formation, and may serve to give us an idea of the long periods of geological time. We do not so readily discern the proofs of the aqueous deposition of the oldest slate deposits, as of those of more recent origin, for in the latter the abundance of marine relics deposited between the strata, indicate clearly that the deposit was originally sea mud or clay, in which marine shell fish and sea weeds lived and grew, marking the different strata by these forms or petrifactions.

Reasoning from these formations, we are led back to the origin of the older strata, and perceive that they were formed in the same way, anterior to the existence of animals and plants. No valid objection can be urged against our regarding the non-fossiliferous slates as having originated in this manner. It would be impossible to conceive of any other way in which they could have been formed.

Strata were originally deposited in a nearly horizontal position. This must have been the case, as the laws of gravitation would allow of no other mode of deposition from water. The only slopes that would have taken place in such deposits are those which might be caused by shelving beaches, where a portion of the land was above the water, and presented a sea coast. Along the borders of the ocean we should then have a gradual slope of deposits which would dip towards it, and which would be marked by the relative coarseness of the sand and gravel next the land, and finer as we proceeded towards the deep water. Submarine deposits even in the most boisterous seas are very nearly horizontal, as has been proved by an examination of the bottom of the British Channel.

If, then, we find stratified rocks standing in a highly inclined position, we are bound to infer that their original situation has been altered by some disturbing cause separate from aqueous action. What are the causes which would effect the displacement of large masses of deposited matter? To this we may reply, that there is no other adequate cause for the uplifting of strata, than that of a deep seated power residing in the interior of the crust of the globe. Reflecting on the prodigious weight of strata, thousands of feet in thick-

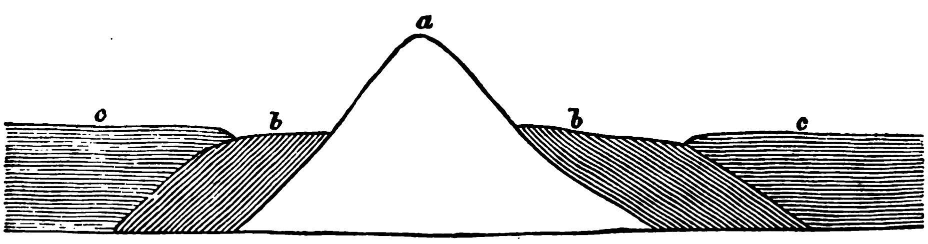
ness, we find all other mechanical forces insufficient for their disturbance. From the action of earthquakes, which have so frequently taken place within the historical period, we are enabled to conceive how internal forces can elevate, depress, disrupt, and overturn the crust of the earth. Mountains, plains, hills and valleys have been seen to rock to their very foundations; yawning chasms have not unfrequently opened and emitted molten rocks, gusts of steam, and acid vapours. The geologist, then, appeals to this great cauldron of molten rocks and pent-up gases and steam, as the motive power, uplifting mountains and rupturing the solid rocks. There is no more difficulty in our conceiving of the adequacy of this force, than in the prodigious power of steam in moving the enormous engines which we daily see in operation. Let any one propose to a child, or to one who never saw this power brought into action, that by boiling water the weighty masses composing the largest class of steam engines could be moved with ease and rapidity, and we might confidently expect the same incredulity would be manifested, as often may be observed among those who are not familtar with geology, at the mention of the internal forces which have moved in former times, and still continue to elevate the rocky mass of the earth's exterior.

In order to conceive a better idea of this power, we must not compare the effect to those of man's feeble contrivances, but should look to the dimensions of the earth's great boiler, and consider the comparative thinness of its sides. Then we shall be less disposed to question its power, and more ready to look with some apprehension lest the crust should give way to a general outbursting of volcanic fire; while on more mature reflection, we shall be thankful in finding that omnipotent wisdom and goodness has provided this vast terrestrial engine with safety valves, which hold all in the most perfect order, and preserve the earth in safety.

By igneous action in former times the earth's surface has been broken up and elevated, not only in single mountain chains, but also in continental masses; while the same power, gently acting, gradually and imperceptibly changes the levels of the land and sea, bringing new territory within the reach of human beings, or maintaining the surface permanently above the sea, acting against its inroads and the degradation of hills and mountains by the continual washing away of their particles to the ocean's bed.

Let us endeavor to represent the action of elevatory forces in uplifting strata, by presenting a diagram illustrating the nature of deposits and upheaval of the strata.

A mountain mass is found protruding through stratified deposits, having the order represented in the annexed wood cut.



a represents a granite mountain protruding through stratified deposits. *b b* which were originally horizontal, as at *c c*. We may then regard the granite mountain as the wedge

which has split asunder and pushed up the strata on each side, while it is a centre of elevation, since through it passes the anticlinal axis, or the imaginary line against which the strata are supposed to rest. The strata *c c* not disturbed by this uplifting force, must have been deposited subsequent to the elevation of the strata *b b* by the eruption of the mountain *a*.

This ideal section or diagram represents, on a small scale, exactly what has taken place on one of great dimensions, extending so widely from side to side that the idea is not at once mastered, and the notebook of the observer must be appealed to in order to make it evident, by a comparison of the dip of strata on the two sides of a great axis of elevation. There are occasionally seen examples on a smaller scale in nature, where the eye takes in at a glance the different points, and the whole becomes obvious to the senses.

Axes of elevation are of three kinds, viz: Anticlinal, synclinal and folded. The anticlinal, as in the above diagram, is when the strata incline towards the supposed central perpendicular line; synclinal, when the strata incline in the same direction; and folded, when the strata are doubled upon each other. The direction of strata is the course which their edges take, their dip is the inclination they make from the horizon towards the earth's centre. The dip is always at right angles to the direction of the strata, and if its direction is accurately measured, the direction of the strata is of course deduced therefrom.

The only instrument required for the measurement of the direction and dip of strata is the Clinometer Compass, which is a small square box compass with the cardinal points at right angles with its sides, and having a pendulum attached to the centre pin, which supports the needle, capable of moving easily on this support.

Rock Formations.

From the foregoing remarks it will be seen that rocks are naturally divided into two great classes, the stratified and the unstratified. It will also be perceived that the former were deposited from suspension or solution in water, while the latter have been melted by the agency of heat. It will be evident, also, that where rocks of aqueous deposition were deposited upon heated rocks, or the latter were elevated against and through the former, that certain changes would necessarily be induced in the chemical and mechanical constitution of the rocks in contact, and to a considerable distance from their junction; hence arises a third division, viz: the metamorphic rocks, or rocks which have changed their structure. These divisions of the earth's crust are strictly natural, embracing no hypothesis, and are mere expressions of well observed facts; and hence are liable to no objections so far as they extend.

It is, nevertheless, important to consider some other methods of classification, in order to present the subject in another point of view, while these divisions do not exclude those above given, but merely subdivide them and group certain rocks according to certain well known laws, while they also give us an idea of the condition of the globe at the time the rocks were formed.

The older geologists, Lehman, Werner and their disciples, first attempted the grouping of the different kinds of rocks according to their fossil contents, calling the oldest and lowest layers which contain no traces of organized beings, either animals or plants, the

primitive or primary formation, the name signifying the priority in age of this group of rocks. Lehman, who first attempted this classification, pointed out the fossils and indicated the secondary formation which rests upon the primary, and includes numerous remains of marine animals and plants.

Werner then set apart the lower portion of this secondary group as distinct from the upper strata, and gave it the name of the transition formation, a name signifying a transition between the primary and secondary, as well as a transition from an uninhabited to an inhabited condition of the world. By this change of nomenclature the numerical division of the strata was in a measure destroyed or rendered irregular.

Above the secondary formation another still more recent deposit took the name of tertiary formation, and was described as filled with organic bodies, very closely resembling those which still exist upon the globe.

Over this we have the diluvial or drift deposits, and modern alluvion.

Although this classification seemed to answer very well in grouping together masses of strata apparently formed under similar circumstances, and hence deriving the name formation; still many interesting and important details were necessarily excluded, and it has been found requisite to re-modify the systems and to express, by new terms, more definite ideas which have been acquired by a more extended and minute examination of the earth's crust.

In the days of Werner the collateral branches of natural history, zoology and botany had not been sufficiently cultivated to serve, with accuracy, the student of geology. chemistry was also in its infancy, and its flickering lamp gave but little light to the geologist and mineralogist, hence many errors which attached themselves to ancient geology, depended upon the imperfect knowledge of other branches of science, and are to be eliminated in our estimate of the early geological works.

Hutton, the celebrated Scotch geologist, first called attention to the proofs of the igneous origin of certain rocks, which Werner had regarded as of aqueous origin, and he succeeded in convincing by far the largest proportion of geologists that his opinions were true, the objections brought by the Wernerians being one by one removed by observation and experiment. Thus, the objection urged by the Wernerians against the igneous origin of certain trap rocks, was that they contained carbonate of lime, which they averred would have been calcined or reduced to the state of quicklime, by the heat necessary to form the rock in which it is found. This objection, at first regarded as well founded, was removed by the experiments of Sir James Hall, who showed that chalk could be melted and crystalized by heat, if subjected to a pressure equal to 1700 feet of water, or about 600 feet of liquid lava. This experiment was regarded as a triumphant refutation of Werner's objections, and the results were carried by special mission to his school in Freyburg. Sandstone was also formed by heating loose sand mixed with salt water, and exposing it while hot to pressure, and the grains of sand were found completely united by the action of the alkaline bases of the sea water upon the silica. Thus it was shown, for the first time, that the chemist could imitate nature's operations, and a new field of research was opened which has not yet been sufficiently explored, and will amply reward those who may continue to make researches, since they will now enjoy the advantages of a more thorough and perfect chemistry.

In more recent times, Rose of Berlin, and other chemists, have by artificial processes made at will crystals of hornblende or pyroxene, one or the other of these magnesian minerals forming, according to the heat and the rate of cooling of the molten mass. Felspar has also been artificially formed by fusing its ingredients in the porcelain furnace, and allowing the mass to cool very slowly. Here then we have proof of the igneous production of some of the most common minerals of granite, sienite, trap rock and lava.

The intense heat of the compound blowpipe invented by our distinguished countryman, Dr. Robert Hare of Philadelphia, has lately been found capable of melting or even of volatilizing pure silex or rock crystal, so that it could be spun into threads like glass. All the metals before regarded as infusible, yield to the intense heat of this instrument, which is destined to throw much light on the theory of the formation of minerals.

Galvanic electricity has melted many substances before regarded as infusible, and in the form of the constant battery has, by an almost imperceptible but long continued current, produced brilliant crystals like those found in our igneous rocks. Fox, Cross, Grove and others have shown the application of this power to the production of metalliferous veins, and it is highly probable that it will throw much light on the history of metalliferous deposits.

We may therefore look to chemistry for information concerning the formation of crystaline rocks, while we regard fossil zoology and botany as guides to the history of the earth's sedimentary deposits, and as indicating not only the relative ages of the different strata and the time required for their deposition, but also for an account of the condition of the globe, and for a description of the numerous races of animals and plants which not only existed, but were also completely exterminated anterior to the creation of the human race. Few subjects have filled the world with greater astonishment than the wonders revealed by the study of fossil organic remains, which the geologist looks upon as the types by which has been printed in the everlasting rocks the most ancient and true account of their origin and age.

By an attentive study of fossils the relative ages of the different strata have been made out with a great degree of certainty; insomuch that by the inspection of a few species the geologist is enabled to decide with accuracy the place which rocks containing them, hold in the order of succession.

It has been remarked that the most ancient formations have identical fossils in all the various countries where they occur, irrespective of lines of latitude and longitude, thus indicating that during the epoch of their growth and deposition, there were no marked differences of climate; while among the more recent deposits of the newest secondary and tertiary formations, differences of climate are strongly marked by the nature of the fossils included in the strata.

The circumstances above alluded to render the study of the ancient fossiliferous rocks much more easy than that of the tertiary, for we have fewer species to examine, and those are universally distributed in the rocks of the same epoch.

Transition Formation, Cambrian and Silurian Systems, New York System.

Geologists have divided strata into groups, which they designate formations, from the

opinion that the rocks thus assembled, were formed under similar circumstances or conditions, and the relative order of superposition, taken in connection with their fossil contents, determined the relative age of each deposit, while the organic beings included in the strata, denoted the circumstances under which the deposit was made. These including marine or fresh water shells or fishes, marine or land plants, serve to indicate the original situation of the materials and their origin.

By observing that certain fossils are limited to a group of rocks, and that they never are repeated in the upper deposits, geologists soon found that a universal law might be discovered, by which the relative order and ages of strata could be decided, from inspection of a collection of their organic remains.

Aided by the light of a more highly cultivated natural history, many active and intelligent naturalists, engaged in the study of fossils and more minute examination of the contents of strata, soon required a greater number of divisions than had before been recognized. Hence a more thorough examination of the oldest fossiliferous rocks, denominated transition or older secondary, resulted in the establishment of new groups, which are designated by new names.

Professor Sedgwick of Cambridge, England, devoted his attention to the examination of the ancient strata of North Wales, and having described the peculiar fossils and the order of strata in a region formerly inhabited by the ancient *Cimbri*, he proposed to name the rocks after the race of men who once lived in that region. Hence he called the lowest fossiliferous rocks the Cambrian system. It is supposed by some geologists that the Cambrian are the altered strata of the lower Silurian system.

Mr. Murchison explored the southern portions of Wales and the bordering counties, besides making extensive researches on the content of Europe, and has published the most complete and splendidly illustrated work on the strata included between the old red sandstone and the Cambrian system of Sedgwick. After consulting some of the highest geological authorities in Europe, he decided to give a new name to the group of rocks which he had especially explored, and named them the Silurian system, from the circumstance of his having had the best opportunity of exploring the strata he describes, in that region of country formerly inhabited by the ancient *Silures*.

Although it is accorded to naturalists that they may give such names as they please to new objects which they discover and describe, still we must regard these terms as merely provisional; for we cannot discover any relationship between rocks formed ages anterior to the creation of man, and the tribes who in comparatively modern times, happened to dwell upon the surface: nor can it fail to strike one as absurd, that the rocks forming a large portion of this continent and that of northern Europe, should be called after the former inhabitants of a small tract of country in England and Wales. We object to the introduction of mere local names into general geology, and would prefer a numerical arrangement, when it can be generally agreed upon by the scientific men of Europe and America. It will be better to adhere to the old groups, primary transition, secondary and tertiary, since these are universally understood and convey with sufficient accuracy the ideas of their arrangement, while each group may be subdivided, at pleasure, into as many strata as contain peculiar fossils.

Before any universal system of geological classification can be adopted, American strata must be explored, and it is evident that at some future day this country will be regarded as the most appropriate region for the study of the older fossiliferous rocks. The New York geological surveyors finding the Silurian rocks well developed in that State, have proposed to call the group the New York system. To this term we object, because it does not seem applicable to other regions, and other States might with equal propriety apply their own names to the same group of rocks, which are by no means limited to New York. but occur, also, in Maine, New Brunswick, Nova Scotia and Canada.

No objection will be made to the application of the names of these newly proposed systems, so long as it is understood that they are local and provisional, for they will merge in any new nomenclature, so soon as one is agreed upon. For the present, then, we may adopt the Silurian system, so beautifully illustrated by Murchison in his splendid work. The Cambrian system of Sedgwick requires a more thorough examination.

"It was not unphilosophical in Werner" (says Mr. Phillips) "to propose for these formations the term Transition rocks—such in truth they are; yet the term will probably fall into disuse, because the enlarged views of modern geologists have led them to recognize, in all the varied mass of stratified rocks, only one long, though locally interrupted series, every term of which is really ***transitive***, connecting the earlier and later formations."

The same difficulty which existed in marking the limits between the transition and secondary formations, also exists in denoting those of the Cambrian and Silurian systems. Fossils mark the latter, and a more general application of similar means limited the extent of the former divisions.

For the present purpose we may say that the group which includes the strata from the primary or non-fossiliferous rocks to the coal measures, may be regarded as the transition, and from the base of the coal formation to the top of the chalk, the strata may be called secondary; while from the chalk to the drift we may include the tertiary. It is well known that each of these divisions has been and will still be subdivided, but still it is desirable to classify in a general manner, in order to refer to each great division with ease and distinctness; while we do not, by any means, exclude the most minute description of each particular group or stratum.

Fossils which characterize the Transition formation.

The Cambrian system contains but few and indistinct fossils, the genera of which are more easily recognized than the species. They occur mostly in the beds of limestone alternating with the slaty rocks. Phillips states that "in the Cambrian limestones occur calamophoræ, lithodendra, cyathophylla, and orbicula. While the Norwegian limestones, supposed to be of the same age, are far richer in zoophyta, crinoidea, and conchifera."

Murchison describes the following fossils as occurring in the Bala limestone: Orthis anomala, O. Actoniae, O. Canalis, O. Compressa, O. Flabellulum, O. testudinaria, Bellerophon bilobatus, and Leptœna sericea. These shells are also found in the lower silurian rocks, hence no Zoological line of division is yet established between these two systems.

Among the curious fossils found in the Cambrian slate rocks are annelida or sea worms, which were first noticed in the rocks of Llempeter, and were not at first referred to any

known organized body, and are described by MacLeay in Murchison's Silurian System. They present the appearance of fringed convoluted striæ, depressed in the slate.

The specices described are Nerites Cambrensis, N. Sedgwickii, Myrianites, Macleayii, and Nemerites Ollivantii. Two species of this order occur in the argillaceous slates of Waterville, Maine, viz: the Nerites and Myrianites. They were formerly regarded as impressions of unknown species of ferns, but appear to be identical with those lately examined in England, and belong to the same group with the European Cambrian slates.

In the lower strata of this system, metamorphic changes have obviously taken place, and all the fossils they contained, if any occurred in them, have been obliterated and crystalized minerals are occasionally observed. Thus andalusite macle, staurolite, mica, hornblend, chlorite and epidote, as well as the induration of the rocks, indicate that the slate was subjected to the action of heat while still in the condition of soft clay or mud.

Metamorphic Cambrian rocks occur in New Hampshire, but they contain no fossils. Iron and copper pyrites, argentiferous galena, iron ores and sulphuret of antimony are the most frequent metallic ores found in rocks of this class. Beds of blue or grey sub-crystaline limestone, retaining their stratiform structure with greater or less distinctness, are also included between the masses of slate strata, belonging to the Cambrian group. These limestones become more crystaline and white, just in proportion as they approach the primary rocks, and sometimes contain ores of lead and copper.

The oldest transition, or Cambrian rocks, occur in Maine and Vermont, and dip in opposite directions, indicating an anticlinal axis in New Hampshire.

On the eastern side of this axis we discover the first distinct fossils in the slate strata on the Kennebec river, where the strata dip boldly to the northwestward.

On the western side we have not yet determined the limits of the Cambrian fossils, but indistinct remains of organic substances, whose nature is problematical, occur in the neighbourhood of Castleton, and along the western flank of the Green Mountains. They were supposed by Dr. Carr, who first noticed them, to be Graptolites, which are supposed to be allied to sea pens. Graptolites are described by Murchison as belonging to the lower part of the Silurian system. He states, however, that these pen-like serrated fossils have a great vertical range in the older or protozoic rocks, being found from the lower part of the Ludlow formation, down to very ancient beds in the Cambrian system.

Should these fossils prove to be Graptolites, they would indicate the proximate limits of the Cambrian rocks on the western side of the New Hampshire anticlinal axis, where the strata dip to the southeastward.

It will be observed that the strata become more and more recent as we proceed eastward and westward from this axis, as is proved by order of superposition, lithological characters and fossil contents of the rocks.

Silurian System.

The rocks belonging to the Silurian system are all stratified, and are characterized by numerous species of fossil crustaceans, marine shells, corals, zoophytes, and marine plants. Like the Cambrian strata, they were deposited by the waters of the sea, as is proved by the organic remains they enclose.

The sedimentary matter was in part derived from the particles washed from the primary rocks, and was deposited from suspension in water, while the shell fish, coral—animals and crustaceans secreted carbonate of lime from the sea water, and added their calcareous matter to the mass, producing beds of limestone, replete with the remains of those animals.

It is evident that this sediment was deposited in a very slow and gradual manner; for it could not have subsided any more rapidly from water in ancient times than now, and the reiterated beds of fossil shells prove that sufficient time was allowed, between each deposit, to permit their growth in each layer of clay or mud, anterior to the superposition of another thick layer, for the shell fish could not live at a great depth beneath this sediment. We cannot reasonably suppose that more than a few inches of clay was deposited in a year, and since the mass of fossiliferous strata is many miles in thickness, we can form some idea of the immense periods of geological time.

Stratified sedimentary matter must have been originally deposited in nearly horizontal layers, and the position of the fossil shells prove that such was the case in these ancient deposits.

At present we observe the strata in a highly inclined position, which must have resulted from subterranean movements, which elevated and broke asunder the strata, leaving them indurated and standing at a bold angle to the horizon.

Owing to this uptilting of the strata, we can easily determine their thickness by ascertaining their limits, and measuring across their upturned edges, while we note the dip and calculate therefrom the depth to which they plunge. It will be seen, then, that the geologist possesses the means of penetrating to a much greater depth into the earth than has yet been reached by any miner, and his results are mathematically certain, so far as relates to his measurements of the thickness of strata, and their depth from the surface.

In Europe the various strata have been studied with more care and detail than we have yet been able to effect in this country, and I shall therefore give some of the results which have been obtained by several of the most distinguished of the British geologists, remarking, however, that America presents a more extensive field for similar researches, since our strata are of vastly greater thickness than those of the British Isles. Omitting the vast masses of primary rocks and the Cambrian strata, as not having yet been measured with sufficient accuracy, and beginning with the Silurian strata, which rest on the Cambrian rocks, it has been ascertained on the borders of Wales that the fossiliferous Silurian strata are 2490 yards in thickness.

The carboniferous system includes—

The old red sandstone,	3300	yards	in thickness.	
The carboniferous limestone,	600	"	"	
Millstone grit,	300	"	"	
Coal,	1000	"	"	
Magnesian limestone,	200	"	"	
New red sandstone,	300	"	"	
	5900	"	"	(See Phillip's Geology.)

Adding together the Silurian and the carboniferous systems, we have eight thousand

three hundred and ninety yards, as the measured thickness of their mass in England, or a little more than four miles. To this the immensely thick deposits of the Cambrian system are to be added. But this group has not yet been measured with sufficient accuracy to admit of its being stated in yards, but we know that it is in this country many miles in thickness. In Maine it has a depth of no less than 30 miles, while in England the aggregate of all the stratified rocks is estimated at only ten miles in thickness.

Mr. Vanuexen, in his report on the geology of New York, has remarked that, "To form some idea of the scale upon which the rocks of the United States have been projected, a comparison, in a few words, with Great Britain may not be uninstructive to many, and not out of place. That little territory, of which England is the head, is emphatically a geological epitome of the world. It embraces all the classes, the groups and rocks generally, and the lesser products; all of which are admirably developed. It is solely to this fact, and the patient industry of its cultivators, that England stands at this time at the head of geology. But how small the scale in Britain, when measured by that of the United States! Here the whole Union, north and south, extending from the Atlantic to the Pacific, is required to show what is contained within the small compass of its three kingdoms."

Fossils of the Silurian System. Anticlinal axis of New England.

Beginning with the Silurian strata at their base, where they rest on the Cambrian, Murchison describes first the Llandelio flags and limestone. Then above these are the Cardoc sandstone and limestone, which two groups form the lower Silurian rocks. Above these are the strata belonging to the upper Silurian, viz: the Wenlock shales and limestone and the Ludlow rocks.

Each of these deposits is characterized by particular fossils, all of which are of marine origin. Among the most remarkable of these are the crustaceans, called Trilobites, an extinct genus, whose remains are so well preserved that naturalists have been able to ascertain their general characters and original habits. Of this family many genera and species have been described, but it will be necessary only to note some of the most interesting and characteristic. Two species appear to be limited to the Llandelio rocks, the Asaphus, Buchii and the A. Tyrannus. In the Cardoc sandstone occur six species of the genus Trinucleus. The lower Silurian strata are generally characterized by including the genera Asaphus, Ogygia, Agnostus and Trinucleus. In the upper part of this system extending from the base of the Wenlock to the Ludlow rocks, are included two species of the genus Paradoxides, two species of Asaphus and Calymene Macropthalma. In the Ludlow rocks the beautiful Trilobite, called Homolonotus, frequently occurs. These fossils are confined generally to the rocks which they are here said to characterize.

The shell fish, which were able to undergo greater vicissitudes of temperature, have a wider range, and occasionally are found in deposits higher or lower than those to which they are supposed to be peculiar, but in such cases they are comparatively rare. The geologist, then, is unwilling to rely upon a single shell as characteristic of any rock formation, and forms his opinion only after consulting a more extensive collection. In the lower Silurian strata occur the following genera of marine shells, regarded as characteristic

of the group, Avicula, Leptina, Atrypa, Spirifer, Orthis, Terebratula, Pentamerus, Euomphalus, Pleutomaria, Nautilus and Bellerophon.

On comparing the descriptions and drawings of the above mentioned crustaceans and shells with those found in the rocks of Maine, New Brunswick, Nova Scotia and New York, it will be seen that there is a close resemblance between them, and sometimes, evidently, identity of species, proving that they were deposited under almost the same circumstances in those distant regions.

It will be remarked, also, that similar rocks and fossils occur at points nearly equidistant from the centre of the great anticlinal axis of the primary rocks, which constitute the basis of the western portion of Maine, the eastern part of Massachusetts and the almost entire State of New Hampshire. Thus, we find the trilobites occur near Lubec, in Maine, on the Tobique river, in New Brunswick, and at Clements, N. S. And in New York the same fossils abound not far west from Albany, at Lockport and Trenton Falls. Beside the trilobites, we observe, also, the same shells in the rocks of Maine, Nova Scotia and New York. This fact seems to indicate that the strata on the N. E. and S. W. sides of this axis belong to the same formation, and were deposited under similar circumstances, while the primary rocks may be regarded as an immense wedge which was driven up from below, separating or disrupting the formerly continuous mass of strata.

If we look still farther north-eastward, we come next to the old red sandstone, forming the base of the New Brunswick and Nova Scotia coal field, the first true coal occurring on Grand Lake, New Brunswick, while larger deposits exist still farther to the eastward, in Nova Scotia and Cape Breton. On looking south-westward we notice the first great coal formation in Pennsylvania, where it is anthracite or non-bituminous, but still of the same age with the bituminous coals of the Alleghany Mountains, and of Kentucky.

The western side of the axis is not known to me in detail, from my own observations, but will be described with minuteness and accuracy by the State geologists of New York; and the geological map of New York will serve for comparison with that of Maine, when the latter is completed.

Secondary Formation, Carboniferous System, &c.

From the foregoing remarks some idea of the great divisions of the primary transition and secondary formations will be obtained, but it will be necessary here to describe some of the most important characters of the secondary formation, beginning with the old red sandstone, which forms the floor of the coal field. This group of rocks consists of stratified matter which is subdivided by Murchison into tilestone, cornstone and marls, and old red conglomerate.

Upon it rests the carboniferous limestone, millstone and the coal deposits, forming a group called the Carboniferous system.

Upon this is deposited the New Red system, consisting of the lower new red sandstone, calcareous, conglomerate and magnesian limestone, on which rest the new red sandstone and marls.

Over the New Red is the Oolitic system, consisting of the Lower Lias limestone, Upper Lias and the inferior Oolite; above which are the Wealden and chalk formations.

3

Each of these systems is characterized by peculiar fossils, different from any we have noticed in the strata before described.

In the old red sandstone group are found the bones and scales of some very remarkable species of fishes, approaching in characters to the crustacean animals. This species was named by Agassiz, Cephlaspis Lyelli, in honor of Mr. Lyell. "A gigantic species of Gyrolepis was also found in the old red sandstone of Fifeshire."

A number of species of fossil shells are also found in this group of rocks, for a description of which the reader is referred to Murchision's Silurian System, and Lyell's Elements of Geology, it being impossible to convey descriptions, that would be generally understood, without many plates which are not authorized in this report.

The old red sandstone does not exist in New Hampshire, but occurs in Maine, at Machias, where it includes fossil shells like those observed in Europe in the same formation. It rests directly upon Silurian rocks, including also the same genera of shells as are found in rocks of that class in Europe. It is not improbable that the red sandstone upon the St. Croix will also prove to be the old red, but no characteristic fossils have yet been discovered in it. It evidently rests on Silurian strata, and is beneath the coal-bearing rocks.

Fossils of the Carboniferous System, Coal, and periods of vegetation of fossil plants.

Having noticed the few remarkable fossils of the old red sandstone, which forms the base of the mountain and carboniferous limestone, it may be useful to indicate the fossils which characterize the coal-bearing strata. They are distinct and well preserved remains of animals of the lower class, and plants of a remarkable nature. The animal remains consist of various extinct species of shells and fishes, the latter generally approaching the sauroid type. Alternate deposits of salt and fresh water exuviæ indicate a corresponding prevalence of those waters, which is to be accounted for only by supposing the land to have been alternately submerged beneath the waters of the sea, and re-elevated so that fresh water lakes should fill the basins formerly occupied by the waters of the sea. In Maryland and Virginia it is certain that there must have been at least three alternate submarine depressions and elevations of the Alleghany mountains, during the deposition of the coal beds, for I observed there three alternations of marine and fresh water deposits.

In the carboniferous limestone of England no less than forty species of conchiferæ and mollusca have been discovered and described. Among the crustacea occur three small species of trilobites, differing from those found in the Silurian system. Some species of Cypris and Limulus have also been discovered. Three genera of fishes were also noticed in this rock, and are described by Agassiz. A few fossil insects have also been noticed. Crinoidea occur in vast profusion: corals are also abundant.

Several peculiar species of the genera of shells, called Productus, Spirifer and Terebratula, also occur with Ammonites, Goniatites, Bellerophon, Dentalium. Species of the genera Euomphalus, Littorina, Lutruria, Melania, Natica, Orthocerata, Turbo, Trochus, Turritella, Rotella, &c., are described by Phillips, Murchison and Sowerby, as occuring in the carboniferous limestone, while "not one of these species has yet been found in the Old Red or Silurian systems."

Forty or fifty species of fossil plants belonging to the orders, Euphorbiacea, Palmae, Equisetacea, Filices, Lycopodiacea, &c., have been found in the carboniferous rocks of England, and have been described and figured by Lindley and Hutton. From the mixed state of the fossils, Murchison supposes that the coal formation principally resulted from the deposition of sediment, consisting of mud and sand, with numerous drifted plants, the whole being washed down into estuaries by ancient rivers, or brought together by marine currents and settled at the bottom of the sea in a gradual manner, where the sediment would of course soon become mingled with marine shells.

Although there are coal formations containing confusedly mixed fossils, yet, as a general fact, this cannot be regarded as true, for it is certain that in most cases we find ample proofs of a slow and gradual submergence of the land bearing its land plants, deep swamps of peat, &c. beneath the waters of the sea, where but little disturbance took place in the leaves of the plants as they were gradually imbedded in the mud deposited upon them. This undisturbed condition of delicate foliage proves that the plants were not subjected to rude currents at the time they were deposited. The perfect state of the marine and fresh water shells indicates the same thing; hence we must regard the matter forming coal, as the product of low, moist and warm bogs, which were at no great height above the sea level, and were frequently submerged and re-elevated during the changeful state of the earth's crust at that epoch. The mud formed the shales or slates and the fine clay which alternate with beds of coal. The sandstone, which also occurs at the base of each coal seam or alternates with the beds, was originally loose sand, the detritus of ancient primary rocks.

Considering the great profusion of casts and remains of fossil plants found in the rocks immediately in contact with coal, and that the coal itself contains charred vegetable fibre, we are irresistibly led to the conclusion that the substance of coal originated from the remains of plants, and this is now the settled opinion of geologists. It has been ascertained that the fossil plants of the coal formation belong to genera similar to those which now flourish only in tropical climates, but the fossil species are extinct.

The greater part of the species that have been found in coal-bearing rocks, belong to the order of vascular cryptogamous plants, (plants having sap vessels and whose flowers are concealed and very minute.)

Brongniart divides the fossils plants into six classes, which he discovered to belong to four periods of vegetation, and arranges them in the following order:—

First period. First traces of vegetable existence found in the transition rocks, and extending to the termination of the coal formation.

The second period corresponds to the new red sandstone formation, and is separated from the first period by the interposition of a kind of limestone called *calcaire peneen.*

The third period begins with the deposit of shell limestone, and extends to the chalk formation.

The fourth period corresponds to the time of the deposition of the tertiary formation upon the chalk. (See Prodrome. Ad. Brongniart p. 219.)

Periods of vegetation of Fossil plants.

Brongniart states that the first of these periods is characterized by the numerical predominance and great developement of vascular cryptogamons plants, which amount to no less than 220 species, most of which are found in the strata contiguous to the coal, or in the shales, sandstones and fine clay, which immediately include it.

The second period does not appear to be so well marked, and contains but eight species of the foregoing families.

In the third period, a great number of cycadæ, ferns and coniferous plants were deposited.

The fourth period is distinguished from the preceding by the numerical predominance of dicolyledonous plants, and by the absence of such as differ much from those now existing on the earth.

It will be observed that the earliest flora of the earth was crowded with plants of the Endogenous class, or those growing from the interior, while in the later periods, Exogenous plants, or those which grow by the deposition of external layers of wood, made their appearance. During the time that the coal formation was in progress, the first mentioned class appears to have almost exclusively prevailed, and from the remains of their luxuriant stems and foliage, the vast accumulations of coal must have been derived.

Although all the species of fossil plants of the coal measures are extinct, yet many of their genera are still represented in more humble and dwarfish species, now growing on the islands of tropical seas; and by examining their structure and mode of development, some idea may be obtained of the characters of the extinct species, which are found in a fossil state.

It has been ascertained that all the plants of the carboniferous rocks belong to classes and orders, which must have required a very warm and humid atmosphere for their growth; a climate like that of the inter-tropical islands of the Pacific ocean, but still warmer and more moist, as appears from the much greater developement of the fossil plants than has ever been observed in any recent species of the same genera.

The coal formation of every part of the world, from milder temperate regions to Nova Scotia, and even so far north as Melville Island, contain the same fossil plants, all being, as before observed, of tropical growth. And since there is every reason to believe that the plants lived, grew and were imbedded in the strata near to, or on the spot where they are found, we are justified in believing that a warm climate formerly existed in high northern latitudes, even to the Arctic ocean. In addition to the proofs derived from the study of the fossil flora, must also be added that drawn from the examination of the fossil shells and fishes—all the fossils of the secondary formation distinctly indicating that a tropical climate prevailed during the epoch of their growth.

Every reflecting person must be struck with the remarkable provision which was made for man by deposits of coal in northern regions, and still more with the reflection that all this was done many ages anterior to the creation of the human race, while it is evident, since civilized man alone makes use of coal, that it indicated his coming upon earth, and that it was prepared for him.

No vertebrated animal, of a higher order than fishes, has been discovered below or in the coal-bearing strata; consequently no animal, capable of the higher sensations, instincts or reflection, existed; for if they had lived upon the globe at that epoch, when the impressions and petrifactions of the most delicate leaves, shells and fishes were permanently retained and preserved, their remains would have been preserved also, and we should find them enclosed in the rocks, for even the footprints of birds are retained in the new red sandstone. Above the coal measures we begin to discover higher orders of animals and plants, which, as we ascend in the strata, become more like those of modern times. In the Oolite, or Roe stone, Lias limestone and Wealden groups of strata are found the skeletons of extraordinary reptiles, partaking of the joint characters of reptiles and fishes, indicating a passage from the anatomical structure of fishes to quadrupeds. They are callad saurians or lizard like animals, but were of marine origin. Such as the Icthyosaurus, Plesiosaurus and Pterodactyle. The first being a large and powerful animal, having the vertebra like those of fishes, the teeth like those of an alligator, and the paddles like those of cetaceans, being, however, four in number.

The Plesiosaurus was a more agile and delicately formed animal, with a very long neck and slender body, having four long paddles or flippers. Both these animals were carnivorous, and they inhabited the warm waters of the tropical creeks, bays and lagoons.

The Pterodactyle was a flying lizard, with large membranous wings, and was also carnivorous or insectivorous in its habits.

For a particular description of these extraordinary creatures, I must refer the reader to Buckland's Bridgewater treatise, and to other elementary works on geology.

In the lower portions of the Oolite group, narrow beds of coal, accompanied by numerous casts and petrifactions of cycadæ, occur. The remains of numerous species of marine shells are also found associated with abundant petrefied corals. The most characteristic shells of the lower Oolite are, according to Lyell, the Terebratula spinosa, Pholadomya fidicula, Belemnites hastatus and Terebratula digonia.

The Gryphea incurva and Nautilus truncatus are found in the Lias, with several species of fishes.

Between the Oolite and Wealden group occur alternations of fresh water and marine deposits, fishes, reptiles, birds and plants. In this group are found the stumps of trees standing perpendicular to the strata, while they incline from the vertical direction just in proportion to the elevation of the strata. They prove that the strata have been uplifted since they were deposited. (See Lyell's Elements of Geol., p. 355–6, London, 1838; also Buckland and De la Beche Geol. Trans., v. 4, p. 220–1.)

Over the above described strata is deposited a very remarkable group of rocks, called the cretaceous or chalk formation, consisting of the green sand and various beds of chalk, constituting, in the aggregate, a mass of more than 2000 feet in thickness. The chalk was evidently formed beneath the sea, as is proved by the marine shells and crustaceans it so abundantly contains. It is regarded as derived mostly from comminuted shells and corals, which were ground to powder by the action of the surf. Among the most remarkable fossils may be mentioned the Belemnite, Ammonite and Baculite, which belong to the family Cephalopoda.

Tertiary Formation.

The tertiary formation rests, in the geological scale, directly upon the chalk, but it is not from this to be inferred that it may not have been deposited on any other rock that happened to be uppermost at the time and place of its deposition. Its geological age is subsequent to that of the cretaceous group. During the epoch of its deposition there existed nearly the same variations of climate as now, and the various portions of the globe had their established mean temperatures. This is proved by the nature of the imbedded fossils, which all mark the nature of the climates to have been nearly as they are at the present time.

The tertiary deposits are sometimes composed of solid rocky masses and regular strata of indurated matter, which is generally calcareous, argillaceous and siliceous, and include a very great abundance of shells, sharks' teeth, charred wood or lignite, and remains of land and fresh water animals, alternating, not unfrequently, with marine deposits.

There is so close an analogy between the fossils of the tertiary group and the zoological and botanical products of modern times, that there is not the least difficulty in deciding upon their genera, and often in determining exactly their species, so that we can say with certainty which belong to extinct species and which to those now living. By collecting all the fossils that are contained in any tertiary deposit, and comparing them with the existing species of the same country, the geologist is enabled to form a scale by which he can classify each of the deposits. Thus Deshayes and others in France determined the ratio of recent and extinct species for each bed of the Paris basin, and laid the foundations of the new divisions of the tertiary, as named by Lyell.

In the lowest deposit a very few recent species were found, and hence it was called the Eocene period, or the dawn of recent species. The next above this was found to contain a minority of recent species, and hence was called the Miocene period, or containing a minority of recent species.

Over this occurs another deposit, which was found to include a majority of recent species, and hence was stated to be of the Pliocene period. Since these divisions of the tertiary have been adopted more recent deposits have been made out, which are called the post pliocene, they being deposited subsequent to that of the pliocene strata.

Among 3036 species of shells of the tertiary, described by Mr. Deshayes in 1833, only 568 species were identical with those found in our present seas.

Of the Eocene group,	42	species	were recent and	1196	were	extinct.
In the Miocene,	176	"	"	845	"	"
In the Pliocene,	350	"	"	429	"	"

(See Lyell's Geology and Hitchcock's Elementary Geology.)

The tertiary formation exists in Maine, and small patches of it are found near Portsmouth, New Hampshire, the latter deposits having been noticed first by Mr. John L. Hayes. Those of Maine have been described, in part, in the various annual reports on the geology of that State.

In Vermont there are also numerous tertiary deposits, which belong to the same periods as those of Maine. Those on the shores of Lake Champlain containing the same fossils

as are found at Kittery point, Portland and Lubec; their living analogues are nearly all found in the neighbouring sea. Higher up in the series is another deposit, which contains some extinct species of shells and the bones of cetaceans. Above this is a still older deposit, in which there are still fewer recent species.

The most recent tertiary of Maine is, at its base, about 30 feet above the high water level, while that more ancient is from 50 to 60 feet, and the oldest from 130 to 150 feet; these different deposits indicating the successive paroxysmal but permanent elevations of the land.

During the tertiary period mammalia birds and other animals existed, but man does not appear to have been an inhabitant of the earth, for not the slightest trace of his remains or any works of his hands have yet been found in the most recent of these deposits.

The sedimentary matter of this formation appears to have subsided slowly, and in very tranquil waters no marks of violence being anywhere observed, while the shells are perfectly preserved, without dislocation of their valves, and the clay forms the most delicate and undisturbed layers of exceedingly fine materials, which must have subsided very slowly from water.

Diluvium or Drift Epoch.

Following this tranquil period came one of great turbulence, the ocean's waters and seas of ice from the polar regions, having been hurled with violence over the surface of the northern hemisphere, breaking up and transporting masses of rocks, and driving the loose materials to the southward and depositing them, not unfrequently, a hundred miles distant from their parent beds. This current appears to have taken place during the period of subsidence of the land beneath the waters of the ocean, a very shallow sea resulting, over which the drift ice transported blocks of stone from one mountain top to another, or dropped them, as it melted, far to the south. Many of the rocky masses of the earth must have been denuded during this violent movement of the waters, for the ledges beneath the soil are found scored with numerous long furrows and scratches indicating the grinding movement or abrasion by rocks and gravel; while the direction of the scratches indicates the course of the current, coinciding also with the direction in which the moved rocks have traveled. This is the general theory adopted by those who have had the best opportunities for studying drift phenomena, and it seems to be the only one that will account for their great extent, and the almost uniform south or south-eastward direction of the furrows in the rocks, and the displacement of large blocks of stone with the smaller boulders, sand and gravel, A more recent theory has been proposed by an eminent Swiss naturalist, M. Agassiz, viz., that there have been periods of intense cold in which large sheets of ice formed in the mountain sides and in their elevated valleys, and that by the expansion and contraction of these glaciers, the frozen gravel and sand, by a sort of filing movement, ground deep furrows in the solid rocks, and rounded and polished the loose stones, while the progressive descent of the glaciers transported the loose masses of rock resting upon it, and deposited them at the base of the declivity. This theory originated among the glaciers of the high Alps, and might, in a measure, apply to some of the phenomena there

observed, but it is, by no means, applicable to the wide spread drift of New England, or to equally extended phenomena in Lapland, Norway, Sweden, Russia and Germany.

Even in Switzerland, many of the best informed geologists are of opinion that it is altogether inadequate for the explanation of the phenomena there observed. M. de Luc of Geneva, expresses strongly his dissent from Agassiz theory, and refers to the admirable descriptions of glacial action by De Saussure. He thinks that the motion of glaciers being effected by their expansion, is purely imaginary. "That the stones and sand frozen into their lower surface, like so many fixed diamonds, smooth and furrow the surface of the rocks," is a mere supposition, reposing on no observed fact. He says the rocks accompanying the glaciers occur upon its sides, very few of them being on the surface. There are but few if any beneath the glaciers, the ancient torrents having removed them from its bed, and they may have themselves produced all the striæ found beneath the ice.

As to the prevalence of intense cold, supposed by this theory, he remarks: "The idea of the prevalence of intense cold in northern regions, in the periods immediately anterior to the historical epoch; a cold so intense, which must have lasted thousands of years, is only founded on equivocal phenomena. Without doubt the fossil bones of elephants and of the rhinoceros, which have been found from Italy to Siberia, announce a cold which had been preceded by a high temperature, which would permit these great animals to live in these latitudes; that is to say, that the climate of Europe and the north of Asia was once much warmer; after which came a sudden cold, which caused them to perish, and at the same time an immense irruption of waters, which buried them. It was then that the difference of temperature of the different zones was established as it now exists. Since that great revolution the cooling has not gone on increasing, but the earth's temperature has become stationary, so that we find no place for the periods of ice; continuing many millions of years, as has been supposed by Charpentier and Agassiz, for it would require millions of years to form glaciers sixty leagues in length and from two thousand to three thousand feet in thickness, as Charpentier supposes, and it would be necessary to have cold equal to that of the glacial zone, and even that would not be sufficient, since for many centuries nothing like it has taken place in Switzerland, in 80° north latitude, nor in Baffin's Bay, 77 N.°"

"The great extent of glaciers of the Alps," he remarks, "is an error of observation, Charpentier and Agassiz having mistaken erratic blocks in the environs of the Jura and Saleve for *moraines* of glaciers" The above extract from a letter from this distinguished geologist, shows that we must be on our guard and not admit this hypothesis without minutely examining the facts on which it is supposed to rest, for "this dazzling system has led many distinguished men into error." Without adducing any more of the conclusive arguments of De Luc, we may examine the state of things in this country, and discover in a short time that the glacial theory of drift is absurd. It is evident that the grooves on the rocks, if produced by glaciers, should radiate from our principal mountain ranges and should be more abundant in their immediate vicinity, while they would be wanting in a level country, or on our extended table lands. Now this is not the case, for the striæ do not radiate from the mountains, nor do they follow the valleys, nor are they more common in elevated regions than on table lands and plains.

In Maine they are better marked than in any other section of the United States, and there they cross the mountains with but little deflection, and run over extensive table lands, where there could have been no slope for a glacier to move upon; and when deflected, it has always been produced by the reflected waters striking against a mountain range, being in such cases turned more into the deep valleys, or towards the beds of rivers. The same phenomena are strongly marked along the Connecticut river, where that stream runs nearly in the course of the ancient drift current. The grooves do not extend from the mountains, but run along their sides nearly parallel with the river. The best preserved furrows and scratches are those which are found on the slate rocks, and where covered by a clayey soil, they are preserved with all their original sharpness. Numerous instances will be mentioned in the subsequent pages of this report. All the rocks of New Hampshire, which have a fine texture, will be found to retain these scratches, but they are frequently effaced where the rocks have long been exposed to the weather, and must be sought for where they have recently been uncovered. This is especially the case with the highly crystaline and coarse granites and mica slates. The same observations apply to other regions, and it has been remarked that in Lapland and Sweden "all the rocks are marked with striæ which are sufficiently compact to receive and retain them." It is also an important element in these observations to note if there is a correspondence in the direction of the drifted rocks, boulders and soil. In Maine, especially, it is perfectly demonstrable that the general current came from the N. 15° W., and went S. 15° E. for not only do the scratches point in that direction, but the rocks of the northwest have been drifted upon other rocks to the S.E. totally different from them, and are so strongly marked that any one would observe that they are strangers to the ledges on which they rest. One of the most remarkable drift rocks of Maine is the hard grey sandstone, formerly called grau-wacke, which is filled with multitudes of marine shells, belonging to the Silurian system. The loose and rounded masses of this rock cover the fields between the Kennebec and Penobscot rivers, and even the islands of Penobscot bay. Now I have traced these rocks to their original bed, which is a belt of fossiliferous strata, running near the height of land on the Canada road, and reaching to the Aroostook river; and it must be remarked that no fossiliferous rock occurs in place between it and the sea, so that it is evident that the loose boulders resting upon the Cambrian slates of Maine, were derived from this northern belt. Again, we recognize certain rocks as peculiar to certain mountains, and find huge blocks of them far the southeastward of their native beds. Ex.—the hard and peculiar breccia or conglomerate of Sugar Loaf mountain is found in Eddington, nearly a hundred miles southeast of that mountain. Instances might be multiplied to demonstrate similar facts, and it is only necessary to allude to but one more. It is the drifted iron ore of Iron mountain, in Cumberland, R. I., which although nearly five times heavier than water, has its loose masses drifted to the distance of more than forty miles southward. (Report on Geol. and Agr. of R. I.

It is worthy of observation that there are found on the surface of the ledges, two sets of grooves or scratches, rarely deviating from each other at a greater angle than ten degrees; and the opening of this angle, so far as I have observed, is greater as we proceed northward. May not this divergence be attributed to the variations in the current of water by tides, which would cause the drifting materials to change their course?

Few subjects have excited greater interest in modern times than the history of diluvial or drift phenomena, and it might be useful to extend this portion of the present introduction, did time and space permit.

Formerly, geologists were inclined to regard the drift epoch as being identical with the period of the deluge, described in the book of Genesis, but more extended researches have satisfied them that it took place anterior to the creation of man; for as before observed, no remains of human beings or of their works are found beneath the drift The usefulness of this flood of waters is sufficiently manifest, since by it soils were removed and commingled, so that the agricultural capabilities of the earth were augmented. But it does not appear that man inhabited the earth before the work of adaptation of it to his wants was entirely completed, even to the preparation of the superficial materials which constitute the basis of all soils.

Alluvium.

This cannot be regarded as a regular formation in ancient geology, for it is continually forming by the action of rain, rivulets, brooks, torrents and rivers, with their freshets, which wash down and remove to a greater or less distance, the fine and coarse particles of the disintegrated rocks and loose soil. By this gradual transportation of fine particles of rocks to lower levels, the meadows and plains are refreshed with new soil, whereby their fertility is increased and supported. Land forms in the mouths of rivers, broad deltas being the result of alluvial transportation of mineral matter. The bottom of the sea receives annual tribute from the mountain sides, and were there no compensating power, the land would ultimately be reduced to the ocean's level, but the gradual and imperceptible uplifting force beneath our continents, generally raises them as fast as the surface wears away, retaining a proper ratio between land and sea.

HISTORY OF THE GEOLOGICAL SURVEY OF NEW HAMPSHIRE.

Long anterior to the actual commencement of the Geological and Mineralogical Survey of New Hampshire, public spirited individuals and executive officers of the government had contemplated the exploration of the natural resources of the State.

Governor Woodbury, in his message to the legislature in June, 1823, recommended an agricultural survey, with a view to the chemical analysis of the various kinds of soils. He quotes in support of his views a passage in the Constitution of New Hampshire, wherein it is stated that "*it shall be the duty of legislators and magistrates, in all future periods of this government, to cherish the interests of literature and the sciences,*" and in which "*the promotion of agriculture, the arts, sciences, commerce, trades, manufactures, and the natural history of the country,*" is especially recommended.

Subsequently, Governor Hill urged the propriety of authorizing a geological and mineralogical survey, with a view to the advancement of agriculture and the arts.

During the administration of Governor Page, and by his earnest recommendation, the legislature of New Hampshire passed an act which authorized a geological and mineralogi-

cal survey of the State. This act was approved on the 24th of June, 1839, and measures were immediately taken to secure the services of a mineralogist and geologist.

On the 10th of September, 1839, I received a commission from the executive department, authorizing me to make this survey, and according to agreement, entered upon the duties of the office on the 1st of June, 1840, and have continued from that time to the end of the term of three years, according to the act of the legislature, to perform this arduous duty. It was understood and agreed between the parties, that the surveyor should devote four months to the researches required in the field, and four months should be spent in the analysis of the minerals obtained; but the work in the laboratory having proved much more difficult and extensive than was at first apprehended, nearly the whole remaining four months of the year were taken up in those researches.

By the act, provision was made for the geologist to appoint a thorough, scientific and practical chemist, to aid him in the analysis of the minerals, but the appropriation was too small to admit my retaining the services of any such assistant, even had it been possible to have found any one competent to the work, who was not otherwise engaged. I, therefore, volunteered to do the work myself, as above stated. Those who are unacquainted with the very numerous, delicate and complicated operations of analytical chemistry, cannot be expected to appreciate the laborious duties of the chemist, or conceive how much time must necessarily have been devoted to the execution of the analyses published in this report. I would, therefore, remark that it has required the most strenuous exertions of my pupils and assistants, with my constant attention and personal labour, to accomplish this work in season. Many of the imperfections that may be found in the style and composition of these pages, must be attributed in part to the protracted duties of the laboratory, which left but little time to draw up our results.

It should be remarked that the act authorizing the geological and mineralogical survey of the State, contemplated no examination of the soils, nor any agricultural investigations: these, so far as I have been able to effect them, are freely contributed.

At the commencement of the survey, it was found difficult to procure assistants who were qualified for the duties, and I was, therefore, happy in being able to offer the services of several of my pupils who volunteered to assist me in the field work, without any charge to the State. They having been engaged for some years in the study of mineralogy, geology, chemistry or civil engineering, proved to be excellent assistants. The State is then under obligations to Moses B. Williams, J. D. Whitney, Eben. Baker, William F. Channing and John Chandler, for their gratuitous services.

In the winter they served in the laboratory, where they were all employed in the analysis of minerals and soils of New Hampshire.

Having performed so much service gratuitously, it was thought proper by the Executive to employ one of these gentlemen in the chemical department, with a remunerating compensation for his expenses. One of the others having been selected as the field assistant for the next year, while the third, being otherwise engaged, was not called into the survey immediately. A small compensation was agreed upon for each of these assistants, in their future employment, but it never amounted to a remuneration for their expenses incurred while they served as volunteers.

During the second summer, Moses B. Williams acted as field assistant, and performed his duties in a most acceptable manner. At the same time, William F. Channing volunteered his services and aided me efficiently, free of charge to the State.

For a part of two winters, Mr. Baker served as assistant chemist in the laboratory, and during a month on the third year, as field assistant.

In the third summer's campaign, Mr. Channing was appointed assistant geologist, and most faithfully performed his duty.

In the winter, Messrs. E. Baker and John Chandler, who had long been my pupils, were employed as assistant chemists, and on expiration of the term of the survey, the latter gentleman continued to aid me gratuitously.

I ought, also, to mention that gratuitous services have been performed by the various pupils who have from time to time been employed in my laboratory, they having worked on New Hampshire soils and minerals.

It may be proper to state that the annual expenses, including the salary of the geologist and the pay of assistants, with that paid out for labour, transportation, &c. &c., never amounted to more than $3000 per annum; so that the three year's work cost $9000, or the sum appropriated by the legislature for this object. There have been but few geological surveys of equal extent, that have been effected at so low a cost, and but few that have brought forth more useful results; for although there is a monotony in the geological formations of New Hampshire, so far as regards the nature of the rocks, yet their frequent dislocations and changes of structure render their study difficult and complicated, while they are not unfrequently filled with brilliant crystals, valuable ores and rare minerals.

FIRST ANNUAL REPORT.

PLAN OF THE GEOLOGICAL SURVEY OF NEW HAMPSHIRE.

In order to effect a systematic examination of the geological structure of the State, it was necessary to lay down some regular plan of operations, and knowing, from previous explorations of the neighbouring States, that the stratiform rocks pursue a general northeast and southwest direction, I was enabled to lay down on the map of the State certain lines, along which our first surveys should extend; intending to prepare sectional views or profiles of the strata, and determine their axes of elevation, and the limits of the unstratified rocks.

If the course or trend of the strata was N. E. and S. W., then a line running northwest and southeast would cut all the stratified rocks at right angles, and exhibit the order of strata and their anticlinal axes; while a northeast and southwest line would exhibit their extent in a linear direction.

By laying out our work in this manner the State would be divided into a series of triangles, which might be again subdivided, according to the minuteness of the surveys required. In some districts, which were complicated or interesting, these subdivisions were made; while in others they were not required, or the limited time allowed for the exploration of the State would not admit of their completion.

Beginning at the southeastern corner of the State, at Portsmouth, our first transverse section was examined and measured from that place directly to Concord, and from thence to Claremont, on the Connecticut river.

Beginning again at Concord, another section was surveyed to the State line, beyond Wakefield; the southwestern portion of this section being continued to Winchester by myself. Then another section was made from Wakefield to Haverhill, on the Connecticut river.

While these lines were explored principally by my assistants, I made a great longitudinal, or rather diagonal, section along the course of the Connecticut river, from Northfield, Mass., to Haverhill, and explored numerous cross sections, from different points, with a view to determining the limits of the rocks, and certain beds and veins of useful minerals. Then every mineral locality, which appeared to be of importance, was examined; speci-

mens of every kind of rock and mineral being obtained for the State cabinet, and for chemical analysis.

It not unfrequently happened, that, on hearing of some locality of minerals, we deviated from our sectional lines for a time, and examined the situation, extent and value of the various ores, or other useful substances, that occurred. Along all our lines we collected specimens of every remarkable soil, learning, so far as possible, its agricultural produce, reserving the specimens for chemical analysis, which was subsequently effected. Deposits of peat, swamp muck, marl and polishing powders were also visited, and specimens obtained and analyzed. Every bed of limestone that occurred was also examined, and the specimens were afterwards minutely examined, in order to ascertain their properties and true composition. All the metaliferous ores that we could discover, were also examined, their extent accurately noted, and the ores were analyzed and assayed, to learn their value and the best mode of working them.

Among the most disagreeable duties of the State geologist was the checking of extravagant and absurd expectations of mineral wealth, which misled some persons of a sanguine temperament. Thus many a delusive hope of possessing rich mines of gold, silver and coal were necessarily dispelled, while those who were effectually relieved from such delusions, were really benefited, by saving any farther expense in unwarrantable mining operations. As a general rule, I have always advised farmers, and men of very limited capital, and without any experience in mining, to avoid embarking in any enterprise of the kind, and to sell their mines, at a reasonable rate, to such as would be able to work them, looking to the collateral advantages they might enjoy from an increased sale of the produce of their farms, or the wood of the forests, and the augmented business of transportation.

In most cases this advice has been heeded, and but very few were found to possess more faith in the magical divining rod than in the sober deductions of science.

Where ancient tradition had conveyed erroneous impressions, it was found more difficult to remove them; hence, tales of Indian discoveries and the speculations of foreign pretenders to a knowledge of mines cannot be, at once, wholly eradicated, and it is to be expected that believers in those absurd notions will still continue to seek for imaginary ores.

Among an agricultural people, no subjects excite a warmer interest than the improvements of their science and art, and it has always afforded me the greatest pleasure to contribute something useful to them. Thus, being able to bring to all who consulted me, the experience of others, or, by an examination of the soil, to suggest, occasionally, some improvement in its cultivation, it is to be hoped that the art will have gained somewhat by the exploration of the soils of the State, and by the communication of scientific principles, on which agricultural improvements are based.

This general outline of our work may give some idea of the various duties which have been attended to in the survey, and no one will venture to regard them as unimportant. Traveling in a wagon, and making frequent excursions on foot, we have always found our time fully occupied in explorations, and the actual number of miles we have journeyed in New Hampshire, in three years, nearly equals the diameter of the globe. Most of the lines of our explorations have been measured barometrically, and certain points have been

determined by astronomical observations and bearings from other places. The direction of every vein of metaliferous ore, or bed of limestone and soapstone, and the course of all the drift striæ on the rocks, have been taken by means of the compass, while the inclination or dip of all the stratified rocks was measured by the clinometer. Many note books we have filled with records of these observations, and from them will be deduced the statements which we shall have occasion to make in the descriptive portion of this report.

THEORY AND DESCRIPTION OF THE PRIMARY UNSTRATIFIED ROCKS.

Rocks of this class are regarded as products of crystalization from a dense, pasty fluid mass, melted by the action of heat. Their metallic elements are supposed to have constituted a part of the original ignited ingredients of the globe, which became oxydized by the decomposition of water that condensed upon its surface, during the first consolidation and cooling of its crust. Astronomers and geologists suppose the original condition of this planet to have been gaseous, the most refractory of its ingredients being retained in the state of vapour, by the most intense heat, and that it gradually cooled into a liquid mass, and then, as its temperature became less, a solid crust of rock formed its surface, and upon this the waters, formerly existing as an atmosphere of steam, condensed, dissolving the soluble salts and forming the ocean. Through this consolidated crust, occasional outbreakings of the internal molten mass took place, and water, the cause of these disruptions, frequently gaining entrance to the ignited matter, was converted into steam, which by its expansive power, elevated the crust and produced extensive igneous eruptions of molten matter. This hypothesis is sufficiently plausible and has been generally adopted in theoretical geology.

That the interior of the globe is now in an intensely heated and molten state, admits of but little doubt, and there can be no important objections urged against its entire original igneous fluidity. The shape of the earth being that of a spheroid of rotation, its equatorial diameter being

al diameter being	7924 miles,
while its polar diameter is but	7898 miles,
leaving a difference of	26 miles

between its two diameters, seems to indicate its original fluidity. The internal heat of the earth has been measured to a sufficient depth to prove its high temperature, while calculations, based on those measurements, show that the crust which is now cool enough to be solid, cannot any where be thicker than 60 or 70 miles.

It appears, also, by historical and scientific evidence, that the surface of the globe has acquired a nearly stationary temperature, owing to the imperfect transmission of heat through its rocky crust, so that an actual reduction of a few degrees of temperature would require centuries of time.

Whatever changes future researches may make in this theory, its general principles will without doubt be retained.

In positive geology we rely wholly on direct observations and inferences from the known laws of nature; but on looking back into the former state of things, we must reason from

analogy, both departments of philosophical inquiry being interesting and important, shedding light upon each other.

It is certain that granitic aggregates were once in a fluid state, for they are observed to penetrate narrow fissures in the superimposed strata, and they are completely melted into the rocks with which they were originally brought in contact. They also produce just such changes in the rocks through which they have been elevated, as are known to result from the action of heat. That the condition of this melted matter was that of a thick paste is evident, also, from the fact that heavy masses of rocks and metaliferous ores, broken from other rocks, and accidentally included in it, did not sink to the bottom, but are retained in its midst or at the surface. The aggregated character of the crystals in granite and sienite, also, prove it to have been a dense and pasty mass, which obstructed the motion of the segregating particles. During the slow cooling of any melted rock, crystalization takes place, and the magnitude of the crystals depends on the degree of fluidity and slowness of the rate of cooling. A mountain mass of granite must have required a great length of time to become solid and cold, and such masses contain large crystals of its integrant minerals.

Having premised the foregoing remarks, it may be useful to state the composition of the principal unstratified primary rocks.

They are granite, sienite and hornblende rock and porphyry. Many varieties of each of these rocks have been described, but some may be regarded as the results of admixture with each other.

Granite.

Granite is the lowest rock that has been reached by the deepest mines, or by geological observation, and it also forms the peaks of many lofty mountains.

It is the foundation rock on which all the more recent formations rest, and many of the superincumbent strata are made up of its fragments; as before observed, it is of igneous origin, and has no stratified structure.

Minerals which enter into the composition of Granite.

Three crystalized minerals enter into the composition of true granite. They are quartz, felspar and mica. Of these species there are several varieties, which are described in works on mineralogy. Many accidental minerals also occur in it, some of which are gems or precious stones.

Quartz.

Quartz is a glassy looking substance, either transparent and colorless, or shaded with various tints, from the presence of metallic oxydes. When pure, it consists entirely of silex. It is, then, altogether infusible by the most intense heat of the furnace, or by the common blowpipe flame, but has recently been melted by the compound blowpipe.

It is as hard as common flint, and scratches glass readily. When crystalized, it generally is found in the form of a six sided prism, terminated by six sided pyramids at each end of the prism, if the crystal formed in a space where the extremities were free from

the rock; but more frequently one end of it is found implanted firmly in the rock where it crystalized, and then only the free extremity is perfect.

The primary and simplest form of quartz crystal is rarely found. It is a rhomboid, having angles of 94° 15′ and 85° 45′. Sometimes it can be cleaved or split so as to obtain this form.

The specific gravity of quartz is 2.645, water being considered as unity.

When struck against steel, quartz tears off small fragments of the metal, which take fire in the air, owing to the heat produced by concussion, and the rapid oxidation of the iron or steel by the oxygen of the atmosphere. It will, therefore, answer for striking fire, like flint.

When two pieces of quartz are struck together in the dark, a faint flash of light is seen, which is not fire, but is an electric phenomenon, called phosphorescence. The rock is found, upon friction, to have become positively electric, but the electricity is preserved only for a moment.

Pure quartz consists of 48.05 per cent. of a brown metalloid substance, called silicium, and 51.95 per cent. of oxygen.

Its chemical formula is $(\dddot{\mathrm{Si}})$

Common sand is composed of quartz or silex. It also enters into the composition of a great number of minerals, and is even found to constitute a certain portion of all plants.

Quartz is used in the arts for various purposes. Pure and transparent crystals are frequently cut, by lapidaries and opticians, into ornaments and into lenses for spectacles. The spectacles, called Scotch pebble, are made of its transparent crystals. Some colored varieties of quartz are highly valued in jewelry, those of a dark, smoky yellow being sold for topaz. The fine transparent varieties, when cut and painted on the back, resemble precious stones.

It is used for making glass, for when it is ground into a powder and is mixed with proper proportions of potash and red lead, it melts, at a white heat, into flint glass, and where no red lead is used, but lime is substituted, it forms a white and hard glass, which withstands better the action of fire and chemical reagents.

In common plate glass, for the manufacture of mirrors, soda is used, instead of potash, as a base.

If too large a proportion of alkali is introduced, it is liable to dissolve in water, and advantage is taken of this property to form a soluble compound, which has the property of preventing the combustion of wood, which is impregnated or covered with a crust of it; for the soluble glass melting when the wood is heated, coats its fibres and prevents their contact with the air, so that they cannot burn.

Granular quartz is very useful for the manufacture of sand paper, and it is largely employed for this purpose in New Hampshire. It is also converted into glass at the New Hampshire glass works in Keene. Pulverized granular quartz is also mixed with white lead, and is found to be useful for painting exposed parts of buildings, for the woodwork will not readily yield to the penknife when encrusted with quartz.

Felspar.

This mineral is not so transparent and brilliant as quartz, and has a very peculiar pearly lustre, so that it is readily distinguished. It is generally white when pure, but from admixture of minute proportions of other ingredients, it sometimes has a red, blue or green tint, these colors being due to small quantities of oxides of the metals.

Although this mineral is described as a single species, it may be regarded as a genus having two or three species, or a general formula may embrace the whole, one alkaline base being replaced by another capable of forming similar combinations. Thus R. signifying the alkaline base, a general formula, $3\ Al.\ Si^3 + R\ Si^3$ will express their composition, the R being replaced by the initial N for soda, or K for potash, or both, as they are found by analysis.

Potash felspar, or orthose, has the following characters: primary form, oblique, rhombic prism, whose angles are 118° 49′ and 67° 15′—hardness, 6—Sp. gr. 2.394 to 2.581—fuses before the blowpipe into a white translucent enamel—gives, generally, a yellow color to the blue flame from the blowpipe, indicating the presence of soda. It is harder than glass, but yields to the knife.

A pure crystalized specimen yielded, according to Berthier—

Silex,	64.20
Alumina,	18.40
Potash,	16.95
Lime traces,	
	99.55

Formula, $3\ Al\ Si^3 + K\ Si^3$ In Abich's Analysis the potash here represented by K., is in part replaced by soda.

A specimen from Bavano, analyzed by Abich.—*J. D. Dana's Mineralogy*—

Silex,	65.77
Alumina,	18.57
Potash,	14.02
Soda,	1.25
Lime,	0.34
Manganese,	0.05
	100.00

Flesh colored felspar, analyzed by Rose, was found to contain—

Silex,	66.75
Alumina,	17.50
Potash,	12.00
Lime,	1.25
Oxide of Iron,	0.75
	99.25

Felspar undergoes a gradual decomposition when exposed to the action of air, water,

and to vegetable rootlets, and the mould of soils. The carbonic acid gas of mineral waters and of the atmosphere acts upon it, so that the alkali is gradually removed, and the mineral crumbles to a fine powder.

When it is moist, this action is quite manifest; but the dry rock is not liable to rapid decomposition, and endures for ages, untarnished in its lustre.

It is the principal source from whence plants obtain the potash which exists in their juices and solid substance, and their operations are the only economical methods known for eliminating this alkali.

Felspar forms, by its decomposition, a very fine unctuous clay, known under the name of Kaolin. It is highly valued for making Porcelain or China ware.

The mineral in its undecomposed state is also employed for this purpose, and is known in China under the name Petuntze. In order to render the felspar suitable for this purpose, it must be heated red hot; then it is to be thrown into water; after which it crushes readily and may be ground into a fine powder, which will form a paste suitable for the potter's wheel. It is generally allowed to remain for two or more years in a moist cellar, in order to become thoroughly decomposed, and then it is more plastic and ductile.

When formed into the shape desired, the paste is first dried slowly, and then is baked into ware called biscuit, after which it is painted, glazed, burnt or semi-fused into fine Porcelain ware.

Albite.

This variety of felspar is generally of a pure white color, and is less transparent than orthose. It crystalizes in the form of an oblique prism, the base being an oblique angled parallelogram, having three cleavages, whose angles are 118° and 62°, 93° 30′ and 86° 30′, 116° and 65′, the most brilliant of which is parallel with the base.

Sp. gr.—2.61. It scratches glass, but yields to the knife. It contains no water. Before the blowpipe it fuses into a white enamel.

The albite of Finland, analyzed by Tengstrom, consists of—

Silex,	67.99
Alumina,	19.61
Soda,	11.12
Lime,	0.66
Oxide of Manganese,	0.47
Oxide of Iron,	0.23

Formula, $3\ A\ Si^3 + Na\ Si^3$ (Beudant's Mineralogy.)

Cleavelandite, so named in honor of Prof. Cleaveland of Bowdoin College, is a variety of albite, containing less soda than exists in the specimen above mentioned.

The Cleavelandite of Chesterfield, Mass., yielded, according to the analysis of Stroymeyer—

Silex,	70.68
Alumina,	19.80
Soda,	9.06
Lime,	0.23
Oxide Mang. and Iron,	0.11

According to J. D. Dana's Mineralogy, its primary form is an oblique rhombic prism. P. on M.=93° 50′. P. on T.=115° 5′. M. on T.=117° 53′.

Another variety of felspar has also been described under the name of pericline, owing to its ready cleavage on all the planes of the crystal. It contains both alkalies, potash and soda.

According to an analysis by Gmelin, it consists of—

Silex,	67.94
Alumina,	18.93
Soda,	9.98
Potash,	2.41
Lime,	0.15

The soda felspars abound in New Hampshire, where the purest kinds may be obtained in any quantities desired. Felspar has been artificially produced in the furnace, and there is every reason to believe that it originated, as before mentioned, from crystalization in the molten mass, which formed the granite rocks.

Mica.

The primary form of common mica is an oblique rhombic prism, whose angles are M. on M. 119° and 121°, and P. on P. 98° 40′. (J. D. Dana's Mineralogy.)

The following analysis will give the general composition of this mineral—

	Pearly white mica.	*Greenish black mica from Siberia,* (*Rose.*)
Silex,	51.3	40.00
Alumina,	31.9	12.67
Oxide of Iron,		19.03
Oxide of Manganese,		0.63
Potash,	6.2	5.61
Magnesia,	3.1	15.70
Fluoric acid,	2.1	2.10
Lime,	5.2	
(Beudant.)	99.8	95.74

Formula, $4\,A\,Si + (K\,Ca\,M)\,Si^4$ Formula, $2(A\,F)\,Si + (Ma\,K.)\,Si$. (Beudant, M.)

This mineral is also an essential constituent of granite. It is easily recognized by its brilliant laminæ, which split readily into thin leaves, when tried by the penknife. It is easily distinguished from talc by its elasticity and its want of an unctious feel when rubbed by the fingers, the latter characters belonging to talc. Mica splits into laminæ of extreme delicacy, the thinnest of which are but 1-10000 of an inch in thickness. It is, when pure, perfectly transparent and colorless, but there are varieties which are colored by metallic oxides, and possess various shades of red, green, brown and black colors. When in a state of decomposition, it frequently presents a rich yellow color, and is sometimes mistaken by those who are unacquainted with minerals, for native gold.

On examining blocks of granite of various shades, it will be found generally, that the colors are produced by the different tints and proportions of the mica which they contain.

In some varieties, however, the felspar is strongly colored, and in the red granites, is the predominant mineral and coloring ingredient. Our common granites, however, more frequently owe their colors to the mica.

Berzelius divides mica into three species, viz:

1st. Mica with a Magnesian base.
2d. " " Potash base.
3d. " " Potash and Lithia base.

There are many varieties of mica in New Hampshire, some of which are different from those which have been analyzed and described. They will be examined and noticed hereafter.

Tha late Dr. Turner of London, analyzed two varieties of mica from Cornwall, and obtained the following results:

	Brown Mica.	*Grey Mica.*
Silex,	40.06	50.82
Alumina,	22.90	21.33
Protoxide of Iron,	27.06	9.08
Protoxide of Manganese,	1.79	
Fluoric acid,	2.71	4.81
Potash,	4.30	8.86
Lithia,	2.00	4.05
	100.82	99.95

A common variety of granite, consisting of three-sixths felspar, two-sixths quartz and one-sixth mica, according to De la Beche, will consist of—

Silica,	73.04
Alumina,	18.83
Potash,	8.51
Magnesia,	0.83
Lime,	0.44
Oxide of Iron,	1.73
Oxide of Manganese,	0.10
Fluoric acid,	0.18

A more common variety of granite, consisting of two-fifths quartz, two-fifths felspar and one-fifth mica, will consist of the following ingredients:

Silica,	74.84
Alumina,	12.80
Potash,	7.48
Magnesia,	0.99
Lime,	0.37
Oxide of Iron,	1.93
Oxide of Manganese,	0.12
Fluoric acid,	0.21

To which a small proportion of lithia may be added, when the mica contains that alkali.

On comparing the composition of the granite soils with the above analysis, a remarkable resemblance in composition will be noted.

Garnets, black tourmaline, beryls and iron pyrites are among the most common accidental minerals which occur in granite.

Garnets occur in red or brownish red crystals, presenting their primary form the rhombic dodecahedron, or with secondary planes produced by replacements of the edges of the primary crystal.

Its specific gravity is from 3.90 to 4.236. (Beudant.)

It melts before the blowpipe into a black globule which is generally magnetic, owing to the presence of the protoxide of iron.

The precious garnet of Bohemia consists, according to the analysis by Vaquelin, of

Silica,	36.0
Alumina,	22.0
Protoxide Iron,	36.8
Lime,	3.0
	97.8

Formula, F Si + f Si.

Finely crystalized garnets occur abundantly in the rocks of New Hampshire, but they rarely possess a sufficiently rich color to render them valuable in jewelry.

There are numerous species and varieties of garnets which possess different colors, according to the nature and proportions of the metallic oxides which they contain.

Thus, a light green variety contains a very large proportion of lime, and but little oxide of iron, and is called from its color, grossular, (or gooseberry green garnet.)

The black garnet, or melanite, owes its dark color to the presence of a large proportion of the peroxide of iron.

Spessartine or manganesian garnet is highly charged with protoxide of manganese, to which its color is partly due.

Tourmaline.

This mineral presents a great number of varieties, which possess different colors, owing to the replacement of one metallic oxide by another, and by their variable mixture.

Their essential ingredients may be stated in general terms to be silex, alumina, and boracic acid with different metallic oxides.

The most common variety is the black tourmaline, commonly called schorl. It abounds in the primary rocks, and is sometimes mistaken for coal, on account of its apparent resemblance to anthracite. The want of combustibility is, however, sufficient to distinguish it from that substance.

Black tourmaline consists, according to Gmelin, of

Silex,	37.65
Alumina,	33.46
Potash and Soda,	2.55
Magnesia,	10.98

Oxide of Iron,	9.38
Boracic acid,	3.83

It melts with difficulty before the blowpipe, and forms a brown or black enamel. Its specific gravity is from 3 to 3.43. It scratches quartz, bnt is softer than topaz. Some varieties of the tourmaline are strongly electric when heated.

Beryl.

Beryl is an abundant mineral in New Hampshire, and occurs in granite rocks. The largest specimens known in the world, were obtained from Acworth. Smaller but very perfect crystals are found in Grafton and in Alstead.

Beryl is a variety of emerald, and differs from that gem only from the absence of the rich green color, due to a minute quantity of chromic oxide.

Beryl of Siberia, analyzed by Klaproth, consists of

Silica,	66.45
Alumina,	16.75
Glucina,	15.50
Oxide of Iron,	0.60

The Emerald of Peru, consists of

Silica,	68.50
Alumina,	15.75
Glucina,	12.50
Oxide of Chrome,	0.30
Oxide of Iron,	1.00

Formula, $2\ A\ Si^2 + G\ Si.^4$

Beryl crystalizes like the emerald in the form of six-sided prisms, terminated by plane summits. The terminal edges and angles are not unfrequently replaced by tangent planes, which rarely cover the plane termination. Its specific gravity is 2.7. It scratches quartz with difficulty, and is scratched by the topaz. It melts with difficulty before the blowpipe flame into vesicular glass. In another section of this report will be seen an analysis of the beryl from New Hampshire.

Sienite.

Sienite is a granite-like rock, composed of crystals of felspar and hornblende, confusedly aggregated. It was thrown up through the granite rocks, and is of more recent origin. It forms large mountain masses, and veins of it are included in most of the primary stratified rocks. Granite veins are intersected by those of sienite, whenever their courses lay across each other. It is a good and tough building stone, and is largely used for that purpose.

The circumstances under which sienite and granite were formed being similar, the two rocks pass by imperceptible shades into each other; quartz and mica being often contain-

ed in it in as large proportions as in true granite. It derives its name from Sienna in upper Egypt, where it was quarried in ancient times.

Hornblende Rock.

Hornblende rock is composed chiefly of the mineral from which it derives its name. It is mixed with variable proportions of felspar; epidote, chlorite and mica not unfrequently occur in it. It is exceedingly tough, so that much force is required in breaking it; consequently it is rarely used for architectural purposes. It generally contains a considerable quantity of iron pyrites, which also disqualifies it for that use. On decomposition it forms a dark red, brown, warm and fertile soil.

Hornblende.

Hornblende presents many different colors; the metallic oxides which it contains being replaced by each other in variable proportions. It is commonly of a dark green color. It crystalizes in rhombic prisms, the primary form of the mineral; also in numerous secondary forms. The angles of the primary form are M on M$=124^\circ\ 30'$, P on M$=103^\circ\ 1'$. Its specific gravity is from 3.1 to 3.4. Before the blowpipe it melts with ebullition into a dark green glass.

Black hornblende of Pargas is composed, according to Bonsdorf, of

	Black.	*and the Green of Aker of*
Silica,	45.69	47.21
Magnesia,	18.79	12.73
Lime,	13.83	21.86
Alumina,	12.18	13.94
Protoxide of Iron,	7.32	2.28
Protoxide of Manganese,	0.22	0.57
Fluohydric acid,	1.50	0.90
	99.53	99.49

Formula, $Ca\ Si^3 + 3\ Mg\ Si^2 + Al$. (See Phillip's Mineralogy, F. Alger's Ed.)

Chlorite.

This mineral is of a rich dark olive green color, and when polished, appears like bronze. It is soft, being readily cut by the knife or turned in the lathe into any desired forms. It is tough, and is indented by the blow of a hammer before breaking. When crystalized it presents the hexagonal form and cleaves parallel to the base of the crystal. Its lustre is pearly. When translucent, it presents the phenomena of dichroism.

Kobell's analysis of two specimens, one from St. Gothard and one from Raunis, gave for its components—

	St. Gothard.	*Raunis.*
Silica,	25.367	26.06
Alumina,	18.496	18.47
Magnesia,	17.086	14.69
Protoxide of Iron,	28.788	26.87
Protoxide of Manganese,		0.62
Water,		10.45
Undecomposed mineral,		2.24
	98.698	99.40

and one from Achmatowsk yielded—

Silica,	31.14
Alumina,	17.14
Magnesia,	34.40
Protoxide of Iron,	3.85
Protoxide of Manganese,	0.53
Water,	12.20
Undecomposed mineral,	0.85
	100.11

Hence there are two distinct species of this mineral, the first being called by Kobel, ripidolite, from the fan shaped groups of crystals.

The massive variety of chlorite was extensively used by the aboriginal inhabitants of New England, for the manufacture of tobacco pipes, bowls, pots and other articles. It is now sought for by the eastern tribes of Indians, who make their pipes of it. It may be turned into handsome vases and boxes.

Gneiss.

In the ascending order, we come next to a rock composed of the same minerals as granite, but which is more or less distinctly stratified in its structure. It is known under the name of gneiss.

It reposes directly on granite, and may be considered as a variety of that rock. Owing to its stratified structure, it splits parallel to the planes of the mica, and large slabs may be readily obtained.

It is extensively used for building and for stone walls. The more compact varieties are commonly sold under the name of granite.

Some geologists consider it to be a metamorphic rock, and as having been originally formed by sedimentary deposition from aqueous suspension. Others suppose that its stratified structure is due to crystalization in laminæ, and that it is merely the upper crust of granite.

If graphite, (or black lead,) originated exclusively from vegetable matter, there is reason to believe that the gneiss once existed as a sedimentary deposit on which vegetables grew, for that mineral is not unfrequently found disseminated in the rock. The enormous thick-

ness of the strata seems to be an objection to the theory of its metamorphic origin, for how intensely heated must the granitic rocks have been, when erupted, to have indurated strata several thousand feet in thickness! Its origin is, therefore, yet an undecided point in geology, and one which may hereafter be settled by the comparison of facts observed at different places. New Hampshire affords the best opportunities for the solution of this problem, for nowhere in the country are there such enormous and reiterated strata of this rock.

The minerals included in gneiss are similar to those found in granite. Veins and beds of metaliferous ores also frequently occur.

Mica Slate.

Mica slate is composed of the minerals mica and quartz. The mica is disposed in regular layers, and is interstratified with fine grains of quartz.

It splits readily into sheets, the surfaces of which are brilliantly plated with the crystals of mica.

When the laminæ are uniformly in the same plane, the rock splits into large even tables, which are highly valued for flagging stones, and they are extensively used for making side-walks in our large cities.

Mica slate is generally considered a metamorphic rock, formed by the strong ignition of sedimentary deposits of the fine particles of granite from water. It exhibits a gradual passage into argillaceous slate, which certainly is a rock of sedimentary origin: hence, we have reason to believe mica slate was produced in the same manner, it having been exposed to a more intense heat, so as to form a decidedly crystalized aggregate.

The strata are frequently contorted and doubled over by the intrusion of granite, which has been elevated through its mass.

In this rock occur a great abundance of valuable and curious minerals, beds of limestone, veins of iron, lead, copper, tin and arsenic ores.

It is a highly metaliferous rock, and should be examined with great attention.

Chlorite Slate.

Chlorite slate is of a dark green color. It is soft, and is easily cut with the knife, and when freshly broken, may be scratched by the finger nail. It is not so unctuous as talcose slate. In the fire it resists an ordinary red heat, but may be melted at a higher temperature into a black slag. When compact and free from quartz, it may be turned in the lathe into various useful articles, such as inkstands, vases, &c.

The compact or crystaline variety which occurs in veins, is, however, preferable for this purpose. It was from this mineral that the aboriginal inhabitants of the eastern States more frequently carved their stone pots and calumets.

At present the Indians of Maine frequent the chlorite veins of Cross Island, for the purpose of obtaining pipe stone.

It serves most perfectly for the purposes above indicated.

Associated with chlorite there frequently occur fine crystals of magnetic iron ore, in the form of the regular octahedron.

Beds of serpentine and soapstone often occur beside those of chlorite, and their frequent association seems to indicate a similar origin.

Hornblende, talcose and chlorite slates often occur in situations analogous to mica slate, and frequently alternate with the latter rock. These rocks are easily distinguished by the presence of the minerals from which they derive their names and characters. Hornblende slate is frequently charged with crystals of garnet and a few other accidental minerals, which will be noticed hereafter. Talcose slate is distinguished by its color, softness, and unctuous feel when it is rubbed by the fingers. It is a valuable rock, since it furnishes an infusible material for the construction of furnaces and limekilns, and when compact and soft, it is largely employed in the arts under the name of soapstone (sometimes called in New Hampshire, freestone.) This rock exists abundantly in the State, and is wrought to some extent.

Argillaceous Slate.

This rock is composed of the finest particles of antecedent rocks, which were deposited slowly by tranquil water. The influence of pressure and heat appears to have consolidated the clay thus formed, into a solid rock, which has a stratified structure, owing to the manner of its deposition.

By subterranean power the slates have been elevated, so that their strata now form a bold angle with the horizon. The upheaving rock in New Hampshire was evidently the granite, which not only uplifted the strata, but also broke through it, and spread upon its surface. On Pequawket mountain, in Bartlett, the traveler may observe a striking instance of such a disruption; for there the broken slate forms a confused mixture with the granite that burst through its strata.

Argillaceous slates are of different ages, and were formed under different circumstances. Those to which I now refer, are deposited immediately upon the primary rocks, and belong to the oldest transition class. Their lower strata do not contain any organic relics, but higher up we find a few remains of marine animals and plants of the simplest structure.

Slate rocks are valuable for use in the arts when they have a uniform cleavage, and are even and sound. The more compact varieties are used for gravestones, while those which are fissile are valuable for covering the roofs of houses.

REPORTS ON THE SECTIONAL PROFILES OF THE ROCKS.

In order to ascertain the extent and limits of the principal rocks, beds and veins, and their relative situation, as also the elevations and depressions of the surface of the country, a series of sectional lines were measured and explored in directions alternately transverse and parallel to the general direction of the strata.

Those who have not attended to the subject, may not fully understand the nature of these sections, and I would therefore observe, that they represent the structure of the country as it would appear, if a straight line was drawn from one of the points mentioned to

the other, and then a perpendicular cut was made through the rocks, along the whole length of the line, quite down to the level of the sea. It is customary, in order to avoid a very long profile, to draw plans in such a manner that the scale of length is considerably less than that of height, but we have endeavored to keep the proportions within proper limits, so that the sectional profiles have a more natural appearance than those which are commonly drawn for such purposes. In limited districts, it is easy to draw plans in such a manner that the scale of length and of height are the same; but one running across a great State, cannot be represented in that manner without elongating the profile so as to render it cumbersome and unmanageable.

Section First, from Portsmouth through Concord to Claremont.

Having examined the extremities and some few points on this line, the survey of a sectional geological profile was confided to my assistants, who performed the work in a satisfactory manner, and their report is herewith presented, in connection with the remarks which I have to offer on the outlines of the geology of Portsmouth and vicinity.

We shall first present a few remarks on the geology of the Isles of Shoals, which are situated near the southeastern extremity of our first section.

Isles of Shoals.

Through the politeness of Captain Currier of Portsmouth, we were enabled to visit the Isles of Shoals, in the U. S. Revenue Cutter. These islands form the extreme outposts of the State, and are situated about 10 miles S. S. E. from Portsmouth harbor, in the open sea. Having frequently seen them at a distance on former occasions, I did not expect to find much that would be interesting in their geology, but since they form the extreme point on our first section, it became necessary to examine them. There are seven islands and a few rocks, which have received the name of the Isles of Shoals. They are all composed of ledges of rock, and but few of them possess any soil suitable for agriculture.

The inhabitants rely mostly on the treasures of the deep for sustenance, and are expert fishermen and excellent mariners. Singular as it may appear, it is stated that on these remote and lonely islands, the first settlers of New Hampshire fixed their abode, and dwelt there many years before settlements were effected on the main land. It is supposed that an isolated situation was chosen in order to avoid the hostile incursions of the savages.

The following are the names of the islands:

1st. Star Island, on which is situate the village of Gosport.

2d. White Island, on which there is a lighthouse.

3d. Hog Island, which belongs to the State of Maine, and has two or three dwelling houses upon it.

4th. The Londoner.

5th. Cedar Island.

6th. Smutty Nose.

7th. Duck Island.

View of Gosport on Star Island off Portsmouth Harbor.

Gosport is a small village, inhabited chiefly by fishermen, whose numerous boats moored near the town, presented the appearance of a grove of slender masts. The town has one small meeting house.

The island is composed of a coarse variety of granite, having large crystals of white felspar, grey quartz and but little mica. Intercalated beds of mica slate, also, occur in the granite. Through the middle of the island runs a large dyke of greenstone trap rock, in a N. 50° E., S. 50° W. direction. There is but little soil on the surface of the rocks, serving in a few places for kitchen gardens for the cultivation of potatoes, and a few ordinary vegetables. The inhabitants depend on the agricultural produce of the main land, and exchange for them the products of the sea. Hog Island is composed mostly of mica slate rocks, and has a thin covering of soil, but is not cultivated to any extent.

White Island, seen from Gosport, to the S. W., off Portsmouth.

Duck Island is composed of granite and gneiss rocks. The only soil existant on its surface fills the irregular depressions of the rocks, and supports a few of the hardy wild

grasses, bushes, and a few maritime flowering plants, which are common on our eastern coast. The Island probably takes its name from the abundance of sea fowl which frequent its shores, and deposit their eggs on the rocks or among the grass.

Owing to the heavy surf which dashed upon the shores of the Islands, we were only able to effect landings in a few places; the others being seen from the deck of the cutter, as we ran close by them, appeared to consist exclusively of coarse granite, broken occasionally into huge cuboidal blocks, and possessing but little geological interest.

Near the lighthouse, at Fort Constitution, on Rease's Island, several large and well characterized dykes of greenstone trap are seen cutting through the slate rocks, and they occur at numerous other places near the mouth of the river.

Having seen all that was deemed essential to our purpose, we returned to Portsmouth and continued our researches in the vicinity of the town.

Geology of Portsmouth and its vicinity.

The geology of Portsmouth is somewhat complicated and difficult.

The principal rocks are of a metamorphic character, or such as have undergone marked changes in structure or composition, by the agency of heat. They are continuations of similar strata which occur at York, in the State of Maine, and exhibit like phenomena.

The rocks to which I refer are the dark blue flinty slates, possessing an imperfectly stratified structure; a very compact texture; sonorous when struck by the hammer, and often breaking with a more or less distinctly conchoidal fracture. Occasionally they evince a passage into an imperfect micaceous slate, especially where they border on granite rocks.

The strata were, doubtless, originally deposited in a horizontal position, and were formed by the deposition of clayey particles from water. Originally it was, probably, in the state of fine blue clay, but when the eruption of the granite and trap rocks took place, the clay became indurated, and was converted into solid rock, while the strata, at that epoch, were tilted up and set on their edges. The same igneous influence, which hardened the clay into flinty slate, appears, also, to have produced a sublimation of iron pyrites, or of sulphur, which, combining with the iron in the clay, formed bi-sulphuret of iron, a mineral abounding in the flinty slate. Another change is also observed in the flinty slate rocks near the railroad cutting in the vicinity of Portsmouth. The rock is filled with an infinity of reticulated veins of carbonate of lime. This crystaline carbonate of lime may have been produced by the fusion of calcareous matter contained in the clay by the action of heat, given out during the eruption of molten rocks protruded from below; this theory of its formation being supported by the results of artificial experiments, and by observations made at many other places, where such an influence is known to have been exerted.

Iron pyrites abounds at the localities above described, and the facts observed appear to give support to the views which we entertain as to the igneous alteration of the rock.

Subsequent to the elevation of the strata of flinty slate, numerous eruptions of greenstone trap rock took place. Extensive fissures having been formed in the rock, the melted trap was injected from below and filled them entirely. From this resulted the veins or dykes. By observations made on the intersections of these dykes, we are enabled to prove that three or more distinct eruptions of this intruded rock took place. Sometimes

the older dykes are cut off, but more frequently they were ruptured in their midst, and a newer dyke runs either through the middle of the older dyke, or between it and the slate rocks which form its borders.

Some fine illustrations of the foregoing remarks may be seen on the sea-coast north of the Little Boar's Head. The dykes at that place vary in width from a few inches to ten feet. They generally run in a N. E. and S. W. direction, with some irregularities and zigzags. These eruptions have evidently taken place nearly in the same line of direction. The more recent dykes, included in or collateral with the older ones, are of a much darker hue, and more compact in texture. The smaller dykes are imperfectly columnar in a direction at right angles with the rock in which they are included, this structure depending on the surfaces where the cooling commenced. Huge masses of trap rock, which cooled from the upper surface, are generally columnar in a vertical direction, as may be observed in Nova Scotia, on the eastern coast of Maine, at Mount Holyoke in Massachusetts, and the Palisadoes on the Hudson river, in New York.

The observer will also remark, at the locality near Portsmouth, that the strata of flinty slate are much contorted, and that this contortion took place, evidently, anterior to the eruption of the trap dykes. He will, also, notice numerous veins of compact felspar in the flinty slate, which probably were formed at the epoch of the elevation of the granite rocks.

The flinty slate occurs, also, in the town of Portsmouth, and along the banks of the Piscataqua river, where the strata are much broken, the joints being generally in directions parallel to those of a rhombic prism. On the margin of the river, near the estate of Ichabod Bartlett, Esq., the slate is divided into such rhomboidal masses, and is torn asunder, during winter, by the action of freezing water, and produces loose shingle of slate, which pave the shores of the stream.

The flinty slate region of Portsmouth is surrounded by granite rocks, which, in numerous places, have been erupted so as to isolate portions of the slate, by intrusion between their masses. Such phenomena would give to a casual observer the idea that the slates and granite alternate with each other.

It will be found, on further observation, that such is not the case, for the primary rocks have merely been forced in between portions of the slate. On our way from Portsmouth to the Boar's Head and Hampton Beach, we had occasion to observe phenomena of the kind above referred to, in the town of Rye. The locality is at the corner of the old road to Portsmouth and the La Fayette road, near the house of Mr Samuel Langdon, 1 1-2 miles from Portsmouth. A mass of granite has there been intruded through the slate, and occupies a considerable area, beyond which the flinty slate again appears, and then gives way to a regular granite and gneiss formation, which extends through a large portion of the town of Rye.

In Portsmouth the intrusion of granite veins and trap dykes into the flinty slate, may be seen in Shoar's woods. The trap dykes pursue a northeast and southwest direction, and are irregularly columnar in a vertical direction.

Breakfast Hill is composed of granite and gneiss rocks, and will furnish an abundance of building stone. The strata of gneiss run N. 16° E., S. 16° W., and dip N. 74° W., at an angle of 70° from the horizon.

It will be seen that the flinty slate region in Maine and around Portsmouth is bordered by primary rocks, and to their influence we have, as before stated, ascribed the metamorphoses which the slate has undergone. The clay forming the basis of the slate, may have been produced by ancient alluvial deposits of the fine particles of the older granite rocks, and the fineness of the particles show that it was deposited by tranquil waters in a very gradual manner.

Granite Quarry in Rye.

In the town of Rye, about a quarter of a mile S. W. from the meeting-house, in the midst of a white pine grove, a quarry has been opened for obtaining granite, which is a light colored variety, of good texture, and splits into the forms desired for building stones. An abundant supply may be obtained, and the locality is valuable, it being in the vicinity of Portsmouth.

MESSRS. WHITNEY AND WILLIAMS' REPORT ON THE SECTION FROM PORTSMOUTH TO CLAREMONT, THROUGH CONCORD.

The geological character of Portsmouth having been before described, Newington is the first town on this section, proceeding westward. It is, undoubtedly, underlaid with clay-slate, similar to that which occurs at Portsmouth, which appears, *in situ*, at Piscataqua Bridge, where it runs N. 80° W., and dips to the north 82°. The surface of this town is covered with diluvial detritus, principally of sienitic granite. Large blocks of this rock occur, and it being a handsome building material, it is quarried for underpinning and other purposes.

The centre of the town is about 150 feet above the sea.

The clay slate occurs on both sides of the bay at the bridge, but, proceeding westward, it is soon replaced by the sienitic granite, which underlies the town of Durham. This rock, which is of a dark color, and a beautiful building stone, has been quarried to some extent at Durham Point, about three miles from the centre of the town. It there occurs in large tabular sheets, or platforms, from one inch to a foot in thickness. This facility of cleavage renders it a valuable material for almost all building purposes, but it cannot be obtained in blocks sufficiently thick for columns. The New Market Mills are built of the stone from this quarry, and it is a valuable addition to the resources of the neighbouring country; but, owing to the transhipment required by the situation of the quarry, it is doubtful whether it can compete, in a foreign market, with others on the coast of Maine, more favorably situated for close access of vessels of any draught of water.

Good specimens of garnets, black tourmalines, and other minerals common in the primitive rocks, are said to have been found in this vicinity.

From Durham to Lee, the surface of the country presents evident marks of powerful diluvial action. The granitic sand is heaped up in hills, some of which are of tolerably regular conical shape, and are elevated from two to three hundred feet above the general level of the surface. On the summit of one of these elevations, about one and a half miles from Packer's Falls, occurs a numerous group of erratic boulders of sienitic granite, somewhat remarkable for their isolated situation and great size. One of them, which has evidently been split in two by the action of the weather, since its deposition on its present resting place, measures sixteen feet in height.

Mica slate first occurs in place, about one half mile E. of Lee church; its direction is N. 60° E., and dip nearly vertical. It is charged with iron pyrites, and is on this account

fast decomposing, giving rise to a soil which is not very valuable without suitable amendments.

Three miles from Lee, a white and beautiful granite shows itself in place, extending for 1 1-2 miles west. This alternates with irregular beds of mica slate, whose general direction is N. 60° E., and dip from 40° to 55° to the south, though in one case a limited bed, filled with quartz veins and evidently disturbed in position, dips to the north.

Boulders of sienite granite and masses of diluvial sand conceal, in a great measure, the underlying rocks between Durham and Nottingham.

The centre of the town of Nottingham, or the "Square," is pleasantly situated on a hill, about 450 feet above the sea level. The northern and northwestern part of the town is quite rocky, but, in general, the soil is well fitted for pasturage, and in a good state of cultivation. Near the centre of the town, on the farm of Mr. Cilley, occurs a large ledge of white granular quartz, which would afford an inexhaustible supply of this valuable material for various purposes of the arts. Grey granular quartz rock, or "firestone," as it is commonly called, found in the S. E. part of the town, has been mistaken for limestone, of which rock no traces have been yet discovered in this vicinity. The unequal decomposition of nodules of quartz in a dark colored granite, in form nearly resembling footmarks, has given rise to some amusing speculations, on the part of the neighboring inhabitants.

The Patuccoway mountains, lying on the line between Nottingham and Deerfield, consist of three distinct elevations, rising somewhat abruptly from near Round pond, known as the Upper, Middle and Lower mountains. They are based on mica slate, which is fast decomposing into soil, from the action of the iron pyrites which it contains, and they consist principally of sienite granite, on which are piled fragments of the same rock and mica slate, in the utmost confusion. Near the summit of the Lower mountain the sienite assumes the form of huge scales, from 12 to 18 inches in thickness.

On the Lower mountain there occurs a dyke of greenstone trap which crosses its summit, and divides it into two nearly equal parts. This dyke is singularly columnar, and on the face of a bare ledge, inclined about 45°, it assumes the form of steps, fifteen to sixteen in number, each about nine inches in height; they are known to the inhabitants as the "Stairs." It varies from six to twelve inches in width, and was traced for a quarter of a mile, till concealed by the soil. Like most of these narrow dykes, the columns were from side to side, of the wall rock, very evidently a crystaline structure, induced by cooling from the sides rather than from the surface.

The height of each of these mountains, above the sea level, is as follows:

Lower mountain,	780 feet.
Upper "	892 feet.
Middle "	827 feet.

A ledge of coarse-grained and well marked graphic granite occurs, near the centre of the town of Nottingham, from under which a small quantity of decomposed talcose rock has been obtained. This deposit is apparently not of sufficient extent to be of any practical value.

It is said that a bed of bog iron ore occurs about three miles northwest of the centre of

the town, which was worked to some extent during the revolutionary war, but the iron not being of good quality, or the supply failing, it was abandoned. Being disappointed in our guide, we were unable to explore it at this time.

Saddleback mountain, which crosses this sectional line, lying in the towns of Deerfield and Nottingham, is elevated about 1032 feet above the sea level. It consists of mica slate, the strata of which run nearly E. and W., and dip to the north 40°.

This rock contains garnets of fine clove-brown color, but of small size; also, well crystalized black tourmaline.

In some cases, the tourmaline in boulders, occurring on the side of the mountain, forms a well marked schorlaceous granite. A single, well crystalized ruby of fine color, but of small size, was found at this place. More careful examination will perhaps furnish interesting specimens for the mineralogist.

Proceeding from this mountain westward, the rocks are mainly coarse-grained felsparthic granite, alternating with mica slate, which dips nearly vertically, and is stratified in a direction nearly N. and S.

The McCoy mountains, based on mica slate, are from four to five hundred feet in height, wooded and pastured to their summits.

Soon after leaving Epsom, the diluvial granitic sand, which fills the valley of the Merrimack, varying in depth, from ten to one hundred feet, effectually conceals all the rocks in place from sight. This, throughout its whole extent, is covered with low pine trees, with a weak undergrowth.

At the Free Bridge, at Concord, the diluvial sand is elevated about 70 feet above the river alluvion, which is there quite narrow. The descent from the plain above, is by means of a natural defile, of suitable width for a road, evidently worn out by the action of water. It would seem that this might have been one of the channels through which the extended plain above was drained, after the deposition of this immense pile of diluvium. Similar defiles occur, of great interest, on the sandy plains of Westfield river, Massachusetts.

Concord is built upon the sandy diluvium of the Merrimack, through which a fine grained white granite occasionally shows itself, forming low ridges of hills. In the West Parish, an extensive quarry has been for some time worked. Large quantities of stone have been furnished for the use of the vicinity, and for the Boston market. Of this the State House is built, and it is the best specimen of the rock which could be shown.

The diluvial sand extends as far as Warner, with a gentle rise as we proceed westward. Beds of mica slate appear above its surface. They are often highly pyritiferous, and by their decomposition, are adding constantly to the mass of sand in the valley. They run N. 45° W., and dip to the north from 50° to 65°.

Large boulders of porphyritic granite are very numerous over the surface, from the West Parish of Concord to the centre of Warner, where we find the rock itself in place. It is a peculiar rock, having large crystals of felspar uniformly distributed through its mass; they are often glassy, so as to furnish beautiful and striking specimens. This bed of granite extends across the State in a general N. E. and S. W. direction; it is from 8 to 10 miles in width, though often interrupted with veins of granite of various texture, often

very coarse-grained, and containing occasional beds of mica slate. Boulders of this rock, which are easily recognized from their peculiar porphyritic structure, are exceedingly numerous to the south, but we have never found them beyond the northern limit of the rock in place. The fragments, which, at first, are of great size and little worn by action of the weather, gradually diminishing in size, have been transported, at least, 10 miles to the south of their native bed. This rock continues, on this sectional line, about three miles west of Newbury, where it is replaced by mica slate, which continues to Claremont. It is generally very much contorted and filled with quartz veins. At the Sugar river falls, the strata dip a little to the E. of S., and run N. and S. In this rock crystals of pyrites, 1-2 inch square, abound.

Green mountain, in Claremont, is based on mica slate; it consists of quartz rock, which has the appearance of regular stratification, but in reality it is a crystaline structure, which divides the rock into huge rhombohedral fragments.

On the side of this mountain, in mica slate, occur large crystals of staurotide of considerable beauty. The micaceous slate on Twistback mountain, is interstratified with small beds of impure blue limestone.

Near the centre of the town an excavation has been made, with the expectation of finding iron. The ore is oxide of manganese, with apocrenate of iron and manganese, and is contained in mica slate.

Sunapee lake, which is about twelve miles in length, is so near the summit level, that a slight excavation would turn its waters either into the Connecticut, or the Merrimack. It is elevated about 1080 feet above the sea level, and the descent of its outlet, Sugar river, to the Connecticut is very rapid.

The sections drawn by the aid of the barometer, which these outlines of their geology are designed to illustrate, are already drawn, and will be published with the other sections and illustrations in the final or general report.

LONGITUDINAL SECTION PARALLEL TO THE GENERAL COURSE OF THE CONNECTICUT RIVER.

While my assistants were engaged in reconnoitering a series of sections which cross the State in oblique directions, alternately transverse and parallel to the general direction of the older strata, I explored the first great longitudinal, and a series of transverse sectional lines. The first longitudinal section runs in a north and south direction, parallel to the general course of the Connecticut river, extending from Northfield in Massachusetts, to Haverhill in New Hampshire, and passes over the principal rock formations of the western portion of the State. The profile of this section represents the elevations and depressions of the country, and the manner in which the rocks are disposed. It presents at one view the relative extent, direction, dip and axes of elevation of the strata, with their principal included beds and veins. It is of an interesting character, both in a scientific and practical point of view, since it exhibits the junctions of the argillaceous slates and limestones with the older primary rocks, and the changes which have been effected in the former by the influence of the latter. Beginning at the southern extremity of this sectional line, I shall describe the outlines of the geological structure of the country which it intersects.

In the town of Northfield, Massachusetts, near the southwestern corner of the State, the red conglomerates and sandstones of the valley of the Connecticut river are seen reposing upon the argillaceous slate rocks of New Hampshire; but the sandstone does not cross the State line.

The conglomerate and sandstone rocks of Northfield, consist of rounded pebbles and finer particles of the primary rocks, such as granite, gneiss, mica slate, quartz and angular fragments of argillaceous slate. These water-worn fragments are cemented together by a paste of argillaceous and calcareous matter, and are colored red by the peroxide of iron. The cement evidently resulted from the abrasion and decomposition of primary rocks, and was deposited by water among the pebbles, and the whole was subsequently indurated by the influence of heat produced during the elevation of the primary rocks. In several places, beds of granite are seen protruding from beneath the sandstone.

The conglomerates of Northfield and of Bernardstown are represented, in Professor Hitchcock's Geological Map of Massachusetts, as the new red sandstone, a rock which overlies the coal measures of Europe; and at one time it was supposed that coal might be found beneath the sandstone of the Connecticut river.

I am confident, however, that it will never be found in the rocks upon which the sandstone rests in this section of the State, for they do not belong to that formation. This

secondary sandstone may prove, like the tertiary formation, to have been deposited on any rocks that happened to be uppermost at that epoch. Similar phenomena have been observed on the continent of Europe and in this country. Whoever examines the conglomerates and sandstones here described, will perceive that the hard pebbles of quartz and granite have evidently been rounded by the action of long continued currents of water. We may, therefore, conceive that, in ancient times, a powerful river of much greater dimensions than the present Connecticut, poured its waters through the highlands, and deposited the detritus of the primary rocks of New Hampshire, and the slates and limestones of Vermont, into an estuary at that time existing in the lower valley of the Connecticut. The waters of such a river would have been able to transport these loose materials to their present localities, the coarser pebbles being left where the current was rapid, while the finer particles were deposited in those wide valleys where the current must have been quite moderate. That the waters of the Connecticut once occupied a much higher level is incontestible, since we have along its whole course regular terraces of aqueous deposition, far more elevated than the waters ever rise in modern times, during the most powerful freshets. Ancient water marks are also observed abundantly on the rocky ledges, at a considerable elevation above the present bed of the river. That the sea entered the valley of the Connecticut in former times, has been most fully proved by the interesting researches of Professor Hitchcock and others, who have examined the deposits of finer slates and sandstones in the lower valley, which contain impressions of fishes and the footprints of wading birds of gigantic size. All the facts discovered tend to prove that the sandstones of the Connecticut, were produced by a deposition of ancient alluvium from the upper section of the river, and that the fresh waters mingled with those of the sea, at least as far up as Mount Holyoke, and that the deposit took place anterior even to the eruption of that mountain, since the trap rocks of which it is composed were protruded through the sandstone, and now rest upon its surface, where they were spread out in a molten state, and now overlap the sandstone.

Argillaceons and Metamorphic Slates.

Our great longitudinal section begins at the Connecticut river, at the southwestern corner of the State, at an elevation of 462 feet above the sealevel, departing from the plains of Northfield and Bernardstown, which are underlaid by the red conglomerates and sandstones before described.

We shall examine next the argillaceous and metamorphic slates on which the sandstone rests. The argillaceous slates, as mentioned in a former section of this report, consist of clayey particles, which were originally deposited by water, and were subsequently indurated by the heat of rocks thrown up in an ignited state beneath them. Where the action of the primary rocks was moderated by the thickness or remoteness of the strata of sedimentary rocks, the effect upon them appears to have been simply to produce induration; but where there was an immediate contact or close contiguity, the slates underwent considerable changes in structure and composition, or are metamorphic.

In the towns of Leyden, Bernardstown and Guilford, may be observed some very inter-

esting peculiarities in the disturbance of the argillaceous slates, such as contortions of the strata, showing that they were once plastic and soft.

The Gorge or Leyden Glen is frequently visited for the sake of its picturesque beauty, and the refreshing coolness of the atmosphere, which renders it a favorite resort for travelers during the heat of midsummer. The curious will also enjoy additional pleasure, if they are led to contemplate the singular geological features which this locality presents. It is evident that the slates have been powerfully acted upon by the protrusion of rocks beneath them, the strata being curved and bent in various directions, while the argillaceous slate exhibits a passage into micaceous slate. Veins of quartz are also seen running through the strata, filling fissures originally produced by ruptures in the slate.

In the town of Guilford several deposits of argillaceous slate have been extensively quarried, so that the situation and structure of the strata are exposed to view. One of the most remarkable localities in this town is the slate ledge owned by Mr. Bruce.

The strata at this quarry are very remarkably situated, and to persons viewing the ledge in front, the slates appear as if they had been broken by a crushing force from above.

Professor Hitchcock supposes this to have been the case, and attributes the fracturing of the slate to the pressure of a huge iceberg stranded upon the out-cropping edges of the strata, during the period of the submergence of the land.

(See view of this quarry in a subsequent part of this Report.)

This quarry is wrought to considerable extent for roofing slates, which are solid and durable, but are not so smooth as those from Wales, or from the quarries in Maine, They are used for covering roofs of houses in Brattleborough, and cargoes are sent down the Connecticut river in boats.

On the western side of the Connecticut river, the argillaceous slate rocks predominate, forming the substrata throughout extensive districts in Vermont, and include many valuable beds of limestone. The same strata extend across the river into New Hampshire, and overlap the more ancient primary formations of Winchester, Hinsdale, Chesterfield, Walpole, Charlestown, Unity and Claremont, exhibiting those remarkable and interesting metamorphoses in structure and composition, which have been alluded to in a former section of this report. It is well known in Europe that the junctions of stratified rocks with the unstratified, are the points most highly charged with metaliferous ores; hence we were led to expect many interesting discoveries in the district traversed by this sectional line.

Leaving the sandstone rocks of Northfield and proceeding northwardly, we pass over Long mountain, in Winchester, and descend to the borders of Ashuelot river. Long mountain is composed of mica slate rocks, the strata of which run N. E. and S. W., and dip to the N. W. The same strata are seen along the banks of the Ashuelot river, in Winchester. Further to the north, we come to granite and gneiss rocks, which form the principal basis of the eastern parts of the towns of Hinsdale and Chesterfield, while on the western side we again observe mica slate strata, which pass insensibly into argillaceous slate, which is frequently charged with iron pyrites. By the decomposition of this, bi-sulphuret of iron, copperas or sulphate of iron, and bog-iron ores are formed. The copperas acting upon the argillaceous matter of the slate rocks, forms sulphate of alumina, which frequently is seen on the surface of moist, sheltered ledges, in the form of an incrustation. Bog iron is form-

ed from the solution of sulphate of iron, which is dissolved from the decomposing rock, and being washed into the low lands, it becomes, by the action of the atmosphere, converted into per-sulphate of iron, which is decomposed by the vegetable matters in the soil, and apocrenated bog iron ore is formed and deposited in low meadows, or on the hill sides.

Veins of magnetic iron ore of considerable magnitude exist in Winchester. Iron pyrites occurs disseminated in the argillaceous slates of Chesterfield, but I have not learned whether there is a sufficient amount of the ore for the manufacture of copperas, the specimens having been sent to me since we left the field. The rocks which most abound in this town, are mica slate, the strata of which dip to the S. E. Near Spofford's pond we observed the junction of this rock with the gneiss, the strata of which dip to the N. W. Near this point is a centre of elevation, as shown by the opposite dipping of the strata.

WESTMORELAND is underlaid by gneiss, granite and mica slate, in every part of the town where the rocks were observed to crop out; but there is reason to believe, from the direction of the strata of argillaceous slates of Hinsdale and Chesterfield, that they also exist in the western borders of this town, but are concealed by the superficial soil.

Many interesting minerals occur in the rocks of Westmoreland, and have long been sought for by mineralogists as objects of study. Some attempts have been made by the people to discover valuable ores, but most of their researches have been fruitless. I was informed by one individual that he had spent no less than thirty years in search of gold and silver ores, and he was still firm in the belief that his labors would be eventually rewarded by such a discovery. On examining the mines where he had spent so much time and labor, we found that he had mistaken some very small veins of copper and iron pyrites for ores of the precious metals. His researches had, nevertheless, resulted in the discovery of some very fine specimens of fluor spar, and tolerably good crystals of quartz. These minerals are found in a vein which is situated near the North Village, on a hill side, two miles S. W. from the meeting-house. The vein consists chiefly of quartz and fluor-spar, with a few small strings and disseminated crystals of pyrites.

The fluor spar possesses various colors, such as white, purple, green and violet; but the light green variety is most abundant. It derives its name from the circumstance of its being used by metallurgists for a *flux* in reducing metaliferous ores. It is from this mineral that chemists obtain that powerfully corrosive acid which has the properties of dissolving silex, and forming with it a gas, and of etching upon the surface of glass. Good specimens are sought for by mineralogists, and chemists occasionally require it in their analytical operations, but it has only a very limited sale.

Flour spar is composed of—

Flourine,	48.13
Calcium,	51.87

or of two equivalents of flourine to one of calcium, and yields

27.86	of fluoric acid
72.14	of lime.

It is readily cleaved by the knife into its primary form, which is the regular octahedron; also into tetrahedra and rhomboids. It is harder than calcareous spar, but may be easily

scratched by the knife. One of its most beautiful characters is its brilliant phosphorescence, when thrown on heated iron.

The purple varieties of fluor spar are frequently cut and polished in the forms of vases, and it is also very successfully employed by the Italians in mosaic work, to represent the rich colors of the grape.

In the south part of Westmoreland we examined a vein of sulphuret of molybdena, which has been opened on the estate of Mr. Lincoln. This locality is one of great interest to mineralogists, and will be visited by many persons for the sake of the elegant specimens of minerals, which have been brought to light by mining operations. The locality is situated four miles south of the north village meeting house, upon the top of an eminence 956 feet above the sea level. The vein is included in mica slate rocks, associated with gneiss. The strata run N. E. and S. W., and dip to the W. N. W. 60°, and the vein runs nearly in the same direction. The sulphuret of molybdena is associated with a peculiar blue compact felspar and quartz, in which occur enormous crystals of the phosphate of lime, a mineral of considerable rarity, and highly prized by mineralogists

On the surface of the sulphuret of molybdena, and in the cavities in the gangue occurs a bright yellow substance, which is supposed to be oxide of molybdena. (See Analysis.)

On the side of this hill a drift has been cut into the rock, with the intention of striking the vein lower down, in hopes of finding ores of copper or of tin, which metals an English miner had led Mr. Lincoln to expect at a lower level. The work was abandoned after excavating a gallery in the rock to the distance of 33 feet, without reaching the vein.

It is true that sulphuret of molybdena is commonly associated with tin and copper ores, but it does by no means follow that wherever we find that mineral, we shall find also the others. If, however, a few crystals of oxide of tin had been found scattered in the molybdena vein, we should have some reason to expect a larger supply in its midst.

Various attempts have been made to render the molybdena ore useful in the arts, and it was hoped that its fine blue oxide might serve as a pigment or for calico printing, but thus far no valuable result has been attained.

This locality will furnish a most abundant supply of sulphuret of molybdena, and should be kept in remembrance, since the constant and rapid improvements in the arts may eventually discover some method of rendering it useful.* At present it is destined to furnish an abundance of fine specimens for the use of mineralogists and chemists, many of whom will visit the locality.

A few rods north of this vein occurs a small deposit of nodular bog manganese, the nodules being about the size of walnuts. It occurs at the outlet of a small drain from a little peat bog, and was evidently deposited in its present situation by water.

This ore will serve for the generation of chlorine gas from muriatic acid for bleaching, but owing to the presence of apocrenate of iron, it does not give out pure oxygen gas when heated to redness, for, that vegetable acid being decomposed by heat and by the oxygen of the manganese, its carbon combining with the oxygen, carbonic acid is produced at the same time. The locality will furnish a few tons of manganese, and since it will answer

* See remarks on sulphuret of molybdena in the chemical department of this report.

for generating chlorine, it will meet with a ready sale at the paper mills, where manganese is used for bleaching.

Having, through the kind assistance of Mr. Lincoln, obtained specimens of the minerals which occur on his estate, we proceeded on our section northwardly.

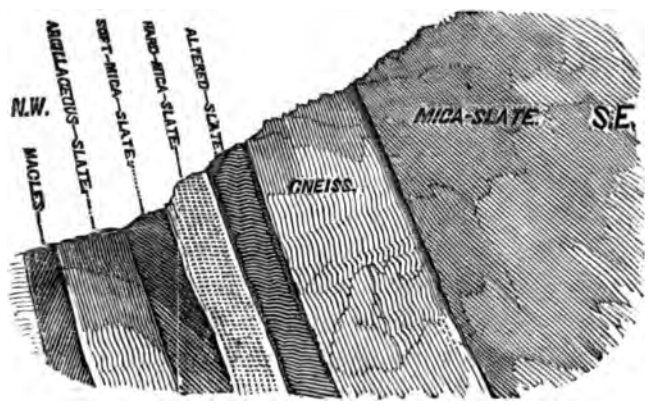
From Westmoreland to Walpole the rocks are granite and gneiss. A few beds and veins of milk quartz also occur.

Walpole. In this town we were aided by Mr. Frederic Vose and Dr. Ebenezer Morse, who were appointed a committee for the purpose, and politely rendered such assistance as was required.

The rocks in Walpole consist of mica slate, the strata of which dip to the N. N. W. 15° or 20°. Granite beds are also observed included between the strata.

These rocks may be viewed near the village, where a small and rapid brook has washed the soil from the surface of the rocks.

It was supposed that limestone occurred on the hill near the meeting house, but we could not find any trace of such a rock. South of Fall mountain, near Bellows Falls, a number of loose masses of plumbago were dug out of the soil, immediately beneath the brow of the hill. They appear to have been detached from the rock on which they rest, since the masses were angular, and not water worn. The rock composing the mountain is plumbaginous mica slate, passing into argillaceous slate on one side, and graduating into hard mica slate, containing fibrolite, on the other. Near the house of Mr. Milliken the slate rocks contain fine crystals of macle or hemitropic andalusite, a mineral somewhat rare. Three miles north from the falls may be seen the junction of the slate rocks with gneiss, these rocks forming the northern extremity of Fall mountain. At the north extremity of the hill the gneiss rocks occur, dipping to the S. E. At the junction of the mica slate with the gneiss, a union of the two rocks is formed. There we notice a dark blue quartz rock, which is followed by indurated argillaceous slate, which passes insensibly into a micaceous clay slate, containing crystals of macle. The strata are overlaid by gneiss, beneath which they dip at an angle of 50°.



Section of the strata near Mr. Milliken's, Bellows Falls.

The rocks at Bellows Falls consist of gneiss and mica slate, the strata of which dip to the S. E. These rocks are filled with masses of fibrolite, which being almost incapable

of decomposition, is left in relief on the surface of the water worn rocks. Fibrolite is harder than quartz, and may be used for emery when it is pulverized and washed in a proper manner.

Near Saxton's river the rocks consist of a hard variety of gneiss, in the crevices of which occur radiating masses of stilbite. In the neighbourhood of Blake's paper-mills the mica slate strata dip S. E. 70°. The same variety of rock, containing fibrolite, exists on Fall mountain, and constitutes its principal substrata. About three-quarters of a mile northwardly from Fall village, on the Rockingham road, occurs a junction of the micaceous and argillaceous slate rocks. At that place the strata run N. 14° E., S. 14° W., and dip to the westward 70°.

Bellow's Falls has long been favorably known to travelers, as a place of resort in the warm seasons, on account of the beautiful scenery and the refreshing coolness of the atmosphere. In ancient times, it was one of the favorite haunts of the aborigines, remains of whose rude sculpture may still be seen on the rocks below the falls.

Alstead. In this town granite, gneiss and mica slate abound. The strata of the two last mentioned rocks run N. E., S. W. and dip to the northwest. In numerous places may be seen large masses of mica slate completely decomposed, and in the state of a micaceous soil. A bed of impure, blue limestone is exposed by the cutting for a road, but it is not sufficiently strong for commerical use.

Eastward of the Paper Mill Village, there occur beds of Potter's clay, and it is manufactured into bricks.

The most important locality in this town is the mica quarry, situated upon the estate of Mr. Goodhue, 3 1-2 miles S. E. from the New Alstead post office.

The mica is one of the ingredients of a very largely crystalized granite, composed of white soda felspar, grey quartz, and large plates of transparent and colorless, or reddish colored mica. The mica is extensively quarried by Mr. James Bowers of Acworth, who devotes himself almost exclusively to the business, and sends large quantities of mica to market. There are two quarries opened in this town. They are situated near each other, and are both wrought by Mr. Bowers. The granite containing the mica, is evidently a huge vein in mica slate rocks, through which it has been erupted nearly in a line with the direction of the strata.

Acworth. The village of Acworth stands upon very elevated land, and is 1397 feet above the sea level. The rocks which compose the mountains are principally mica slate and granite, the latter rock constituting large veins in the former. Hornblende slate and quartz rock also occur on and around William's hill, an eminence situated S. by W. from Acworth M. H., on the south side of Cold river. This locality has enjoyed great celebrity on account of the immense crystals of beryl which have been obtained from it, and have been sold for cabinet specimens in various parts of the world. Some of the crystals are more than a foot in diameter and eighteen inches in length, but they are, like all gigantic crystals, defaced by striæ and cracks which injure their beauty. Notwithstanding these imperfections, the huge dimensions of the crystals has produced great surprise among mineralogists and geologists of Europe. One of these beryls, eight inches

in diameter, was shown me in the Imperial Cabinet of Vienna, as a remarkable specimen, and was a very highly valued present to that superb collection. The Acworth beryls, when perfect, have a fine light blue green color, and are of that variety known by the name of aqua-marine. Fragments may be separated from some of the large masses that would serve, when cut and polished, for jewelry. The large crystals, generally, are not sufficiently free from foreign matters for this purpose. The locality from whence these beryls were obtained, may still yield a great number of valuable specimens, but much labor is required in blasting away the quartz rock which overlies them, before they can be detached. They occur in a granite vein immediately beneath a large vein of granular, white and rose colored quartz. The quartz vein runs N. W. and S. E. and forms the summit of the hill, and is no less than forty yards wide, and is easily quarried. It is of the purest and best kind, and is suitable for the manufacture of glass and for sand paper.

Black tourmalines and largely crystalized white soda felspar, or Cleavelandite, occur at this place, but the specimens are not so good as those which are found at the mica quarries of Alstead.

On the western side of William's hill there is a bed of well characterized hornblende slate, which is cut through by a broken vein of compact felspar in a remarkable manner, evincing many ruptures in the vein subsequent to its injection. The strata are much contorted near their junction with this vein.

A compact felspar vein in hornblende slate rocks, exhibiting several remarkable fractures and dislocations, William's hill, Acworth.

In the village the strata of mica slate are observed near the tavern, where they dip to the W. S. W. and run N. 10° W., S. 10° E. Several small veins of granite and beds of quartz also occur in the rock, and contain masses and crystals of iron pyrites. Further north the dip of the strata is reversed, the inclination being to the E. N. E. 50°. Proceeding to Unity and Claremont, the road forms quite a regular inclined plane, descending rapidly to the northward.

UNITY possesses many interesting localities, some of which have been explored.

The granular quartz, which is found upon the estate of Mr. J. M'Clure, has for a long time supplied the sand paper works of Vermont with the ground and sifted mineral, employed for the preparation of that useful article. The bed from whence the quartz is obtained, is included in granite, and is conveniently situated near the mill where it is

ground and bolted. An abundant supply of the rock may at any time be obtained. It is more largely granular than the quartz of Acworth, but is easily ground to powder in a common grist mill, furnished with granite mill stones.

Half a mile northwardly from Mr. M'Clure's house, there is a strong Chalybeate spring, which has enjoyed some celebrity in the cure of certain derangements of the digestive organs. It is strongly charged with salts of iron, and possesses tonic properties.

The soil around the spring is so highly impregnated with sulphate of iron, that no plants are able to grow upon it except a little moss in some places, which is soon blackened and destroyed when the solution of copperas in the soil becomes concentrated by evaporation.

Copperas has been manufactured from this soil, simply by the process of leaching and evaporation.

A few limited deposits of bog iron ore, of local formation, occur in this town, but none appeared of sufficient magnitude to warrant mining operations.

On the estate of Mr. James Neal, we examined a large vein of copper and iron pyrites, which has been explored to some extent.

This vein is contained in gneiss, and runs nearly parallel with the strata, in a direction N. 10° E., S. 10° W., and dips to the W. by N. 78°. It extends along the top of the hill for the distance of 1,550 feet, and in the valley is covered by the soil, but it again appears on the uplands beyond. The whole extent of the vein is not less than 2,200 feet in length, and its width at the opening which has been made, is, at 3 feet from the surface, 1 foot and 8 inches, and at 8 feet, it is 3 feet wide. In some parts of the vein the width is 3 feet 9 inches. It will be perceived that the vein widens as it descends, and there is reason to believe that it may ultimately be wrought for copper, and for the manufacture of sulphate of iron. (See analysis of this ore.)

If the mine is wrought, it will be found easy to effect drainage to the depth of 70 feet. It is situated 4 miles from Charlestown landing, on the Connecticut river.

At this place we discovered a new mineral, to which I have given the name Chlorophyllite. (See report on the analyses of minerals.) It occurs in the sienite rocks which are found imbedded in the gneiss near the copper mine. Crystals of magnetic iron ore in octahedral forms occur, disseminated in the green mica, also radiated actynolite and garnets. Green mica is also associated with the Chlorophyllite.

Near the northwestern corner of Unity the argillaceous slate rocks occur, overlapping the older primary strata. A quarry has been opened for the purpose of obtaining tombstones, but it has not been much wrought.

Claremont is intersected by the sectional profile measured by Messrs. Whitney and Williams, who have described the outlines of the geology of that town. It will, therefore, be unnecessary for me to do more than refer to their description of the section from Portsmouth, through Concord, to Claremont.

From Claremont to Meriden the micaceous slate rocks prevail, and are occasionally colored by the presence of plumbago. The strata run N. 20° E., S. 20° W., and dip to the E. S. E. 20°. Near Cornish Flat the mica slate becomes more silvery in its lustre, and is not colored by foreign matter. In several places the rock splits well into platforms,

and may be quarried for flagging stone. Mr. Hock Hills informs me that good tombstone slates are extensively quarried 1 1-2 miles S. E. from Cornish Flat. The stone is said to be much better than that wrought at Unity and Claremont. It is exported largely for sale, and is even transported to Portland, in Maine.

In Meriden hornblende slate and chlorite slate occur. The latter rock extends through Lebanon 4 miles towards Hanover, where it is interrupted by granite. The chlorite slate dips to the northwestward.

Hanover has been pretty thoroughly explored by the professors and students of Dartmouth College, so that little remained for us to examine, save the measurement of our sectional line through the town. The most interesting rocks which occur, are the hornblende slates, which contain an infinite number of small but perfect crystals of Almandine, or precious garnet crystalized in its primary form, the rhombic dodecahedron. The locality from whence the best specimens are obtained, is directly in the rear of the Medical College, where the hornblende slate crops out on the crest of a moderate hill, the strata running N. 40° E., S. 40° W., and dipping to the northwestward 40 degrees. By means of a single blast, it is easy to obtain a large supply of very fine specimens.

In the northern part of this town plastic clay and clay marl occur in regular strata, which are nearly horizontal. On the estate of John Durkee, Esq., the marl is highly calcareous, and will serve for fertilizing the soil. Specimens of this marl were presented to me by Dr. C. B. Hamilton, of Lyme. He informed me that attempts were made to burn it for bricks, but the bricks were found to slake and crack when exposed to the action of water. This circumstance led him to suppose that the clay contained lime, which fact has been most fully confirmed by analysis. (See the chemical department of this report.)

Blue limestone occurs, also, in the northern part of Hanover, and is of sufficient purity for the manufacture of lime for mortar, and for agricultural use. (See analysis.)

Lyme. This town was partially examined while we were engaged upon the section, but much still remains to be done. Many highly useful substances occur, and will need a more full survey. Rev. Mr. Buck, the principal of the Academy, has already collected a great number of highly interesting minerals in the vicinity, and Dr. Hamilton has examined a deposit of clay marl which is quite valuable for agricultural use.

Aided by this gentleman we visited the localities, and ascertained the existence of marl throughout an extensive district. It occurs in thick beds on the cliff and on the margin of a brook, and between the East and West Villages on both sides of the road. The marl is evidently an ancient drift deposit, since it is far above the level of any stream at present existing in this region. It was formed by the decomposition and disintegration of a blue limestone, fragments of which are still found imbedded in the marl. Where it is exposed to the heat of the sun, the surface becomes indurated, so that it requires the use of a pick in digging it out of the bank.

The richness of the marl may be estimated coarsely by pouring upon it some muriatic or nitric acid, and judging by the degree of effervescence which takes place from disengagement of the carbonic acid gas. An exact analysis of it will be found in the chemical

part of this report. It is evident that by use of this substance the farmers may highly improve the sandy soils in the West Village and its vicinity, and it is somewhat remarkable that attention has not before been paid to the subject. Dr. Hamilton says that limestone, of good quality, and marl abound also in the north part of Lyme. He furnished me with specimens which have been carefully analyzed in my laboratory, as will be seen reported in the tables of chemical analyses.

During our next campaign, we shall ascertain the extent and economical value of those beds of limestone, and shall examine several veins of metaliferous ores which occur in the vicinity. Some masses of cyanite have been found in the northwest part of this town, by Mr. Buck. Copper pyrites has been found in the S. E. part of the town. Black tourmaline in distinct crystals occurs in the rocks in large quantities. One small but beautiful specimen of quartz, containing rutile, was found in the soil. Iron pyrites occurs on the estate of Mr. Holt, and formerly gave rise to absurd expectations, it having been mistaken for an ore of the precious metals.

The mica slate rocks which crop out in the East Village, along the borders of the stream, are occasionally impregnated with disseminated crystals of iron pyrites. It also exhibits a gradual passage into plumbaginous clay slate. The strata run N. E. and S. W., and dip to the N. W. 52°. Drift boulders of granite and of quartz rock also abound on the surface.

Two small veins of copper pyrites are said to occur in this town, to the eastward of the East Village, but our time did not allow us to visit them.

From Lyme to Orford the rocks are mica slate, with occasional veins of granite.

Orford. In this town we were assisted in our explorations by Dr. Hosford, who has made a collection of the most interesting minerals of the neighborhood. Sunday mountain, in the south part of the town, consists of granite which is of good quality, and is quarried to some extent. It is composed of white felspar and black mica, and contains but little quartz.

Two miles north from the village occurs an immense bed of compact talcose slate, which answers perfectly for soapstone, and is quarried to some extent, but may, by proper management, be made to furnish an almost unlimited quantity of that valuable material. The bed is included in mica slate, and dips with the strata of that rock to the N. 10°, W. 35°.

The mica slate may be seen cropping out at the summit of the hill, and also at the base; but the walls of the talcose rock have not been fully explored. We may, however, safely estimate the thickness of the bed at 100 feet, and it probably is even of greater dimensions. The present mode of quarrying it is troublesome and slow. The workmen who hire the privilege of obtaining the stone, since they do not own the ledge, are unwilling to expend a large sum in clearing the quarry so as to obtain a good head, and consequently have to work at disadvantage. A large amount could be profitably expended in preparing the quarry, so that the stone could be more easily obtained.

Clove brown tourmaline, a rare mineral, occurs in the talcose slate in large crystals, some of which are more than two inches in diameter and six inches in length. They are rarely found with perfect terminations. Radiated brown tourmaline is much more abundant, and is easily obtained at the quarry.

The composition of this mineral will be stated in the chemical department of this report.

Granular limestone also occurs in Orford, but does not appear in our line of sections. Specimens were obtained for analysis.

PIERMONT. Leaving Orford and proceeding northwardly, we next pass through Piermont, the rocks on the route being uniformly mica slate strata, with occasional protruded masses of granite, and veins of quartz, and numerous dykes of greenstone trap rock.

In this town occurs an important bed of micaceous specular iron ore, which was examined with care. This bed occurs on an eminence known as Crosses Ore Hill, and is 4 1-2 miles S. E. from Haverhill corner. The iron ore is contained in stratified quartz rock, and follows the course and dip of the strata, the direction being N. 15° E., S. 15° W., and the inclination W. by N. 26 to 30°. We traced it along the crest of the hill for the distance of half a mile. The beds are very numerous, and are contiguous to each other. They vary in thickness from a few inches to three or four feet. At the southern extremity of the hill, the ore presents itself in larger beds, the outcropping ends and edges being fully exposed to view. At this extremity it is best to commence the work of mining, since it may be more readily transported to the road below, and from thence to a furnace. The slope of the hill is at an angle of from 22 to 25 degrees to the road, and is quite regxlar, so that a slide may be constructed for transportation of the ore to the road.

The highest crest of the hill is about 300 feet above the immediate base, and at the south extremity of the bed, the elevation is from 150 to 200 feet above the road below. There appears to be a sufficiency of iron ore at this locality to warrant the erection of a blast furnace. A considerable amount of the ore has already been converted into good cast and bar iron, at Mr. Huxan Paddock's furnace in St. Johnsbury, Vt. (See Chemical Analysis.)

Owing to the presence of a small proportion of oxide of titanium, it is more difficult to reduce than some other varieties, but this is not a serious obstacle, considering the minute proportion of titanium which the ore contains. It is always advisable to mix such heavy ores with bog iron ore, if it can be obtained, since it serves to facilitate the reduction of the specular iron ore, and lightens the charge in the furnace. A limited deposit of compact and dry bog iron was found near the base of the hill, but not in sufficient quantity to render it available.

Another small deposit exists on a branch of the Oliverian stream, but the quantity is said to be insufficient for iron works.

In the bed of specular iron ore occur occasional masses and veins of sulphate of barytes, a mineral commonly used for the adulteration of white lead.

On the hill opposite the specular iron ore, on the land of Mr. Tristram Cross, there are several small veins of magnetic iron ore, varying in width from 1 to 4 inches, which alone would not be considered of any economical value, but these small veins will furnish a valuable contribution to a blast furnace, where the specular iron ores may be smelted.

Green, white and brown micas are found associated with this ore.

A few fine crystals of phosphate of lime, of the variety called apatite, occur imbedded in masses of limestone, which are found loose at the base of the hill.

Attempts have recently been made to discover coal in the plumbaginous slate of this town, but, as might have been anticipated, without success, since the rocks do not belong to the coal formation. On our route from Piermont to Haverhill corner, we passed over nine dykes of greenstone trap rock, which have been erupted through the mica slate rocks. Some of these dykes consist of the porphyritic trap which is the most ancient variety.

HAVERHILL. During our sojourn in this town, His Excellency Governor Page kindly devoted his time and personal attention to the survey, and aided us in the work.

With him we visited several localities before described, and those which will next occupy our attention.

The plain at Haverhill corner is covered mostly with ancient alluvial soil, which conceals the rocks, but the strata may be examined on the hills and mountains around where their outcropping edges are fully exposed. Mica slate is the predominating rock, and it is occasionally interrupted by veins and beds of granite and quartz rock. Extensive beds of excellent limestone are also included in the mica slate. Many curious and useful simple minerals were also found in veins traversing that rock.

Granite of good quality exists abundantly on Catamount hill, situate southeast from the village. The hill is mostly composed of tabular sheets of granite, which affords great facilities to the quarrymen. The sheets of granite have no stratified structure, but are pseudo-strata. They slope to the W. N. W. 20°, and large platforms are readily split off and taken down the sloping hill. This stone is extensively quarried, and is used in Haverhill for fence posts and for underpinning. Large quantities are also sent over into Vermont for sale, and it is even transported to towns 20 miles distant.

Among the interesting minerals which have been found in Haverhill, we may mention small veins of copper and iron pyrites, sulphurets of lead and of zinc, native arsenic, arsenical pyrites, large crystals of garnet in chlorite, some of which are 1 1-2 inches in diameter, and are crystalized in the primary form, talcose rock or soapstone, and granular white limestone of excellent quality.

The extent and value of these minerals were carefully ascertained, and specimens of them were collected for the State cabinet and for chemical analysis. Several of those first mentioned were discovered by Mr. Roswell Wilmot. Copper pyrites occurs in a vein of white quartz traversing mica and hornblende slate strata, on the estate of Mr. Francis Kimball, between the Great Ammonoosuck and the Wild Ammonoosuck rivers.

The vein is from one to four inches wide, and is quite irregular; the copper ore occurring in bunches or nests in the quartz. Galena or sulphuret of lead, and blende or sulphuret of zinc are also found in the same situation. The direction of the vein is N. 10° W., S. 10° E. It intersects the strata at an angle of 70°, the mica slate strata running N. and S. and sloping to the westward.

Passing over the hill to the west, we next came to a dark blue variety of mica slate, which is stained by plumbago and iron pyrites. This rock includes beds of native arsenic, which is so free that it is volatilized by the heat of the sun, giving a strong garlicky odor to the atmosphere on a hot day. When struck by the hammer the arsenical odor is very strongly perceived. The arsenic is in thin layers, forming beds with the slate 3 or 4

inches in thickness. It is probable that ores of cobalt will be found associated with this mineral. Mr. Wilmot thinks that he found traces of it in one of his specimens.

White and magnetic iron pyrites also are found at this place. In one of the dykes of trap rock on the hill, there is so much magnetic pyrites scattered in fine particles in the rock as to give it a decided polarity; so that approaching a compass to one point on the rock the needle points to it, and is reversed when the compass is carried a few inches beyond it. Yet there is nothing more to be seen at that point in the rock, than elsewhere in the ledge. It is merely a magnetic pole of the mass.

The mica slate rocks of Vermont and New Hampshire frequently include valuable beds of limestone, which is generally crystaline in its character, and exhibits no remains of fossils. This variety of limestone is supposed by many distinguished geologists to have been originally an aqueous deposit of marine shells and corals, which subsequently were melted into crystaline carbonate of lime by heat, while the pressure of superincumbent rocks and of the ocean, prevented the escape of the carbonic acid gas. By artificial experiments, Sir James Hall long ago demonstrated the probability of such a metamorphosis, and since then Von Buch, Elie De Beaumont, Dufrenoy and others have by observation proved that many limestones, originally consisting of shells, have been converted into granular marble and crystalized limestone, by the agency of erupted rocks.

I have seen but one locality near the upper waters of the Connecticut, where any traces of organic forms could be discovered in the limestone, and in that instance, if remains of corallines originally existed, they have been so altered that no trace of organic structure remains. By means of extended researches on the Vermont side of the Connecticut river, we may perhaps be able hereafter to satisfactorily account for the origin of the limestone in question.

From observations at other localities, I am disposed to consider all those limestones which were formerly called primary, to be metamorphic rocks, produced in the manner before stated. It is also an interesting fact, that the limestones in the mica slate in the region about to be described, are free from magnesia, while those beds in other portions of the country, which are included in talcose slate and hornblende rock, or which occur in the vicinity of serpentine rocks, are generally magnesian, especially where in contact with those magnesian rocks.

Our present section passes over an important bed of limestone, which occurs about six miles northeastward from Haverhill corner, on the west side of Black mountain, and to the northwest of the Sugar Loaf, near the foot of which it was first discovered, forming the basin of a small spring. This spring had excavated a deep well in the rock, so that a pole could be thrust down to some depth. The limestone forms regular beds of great dimensions and will make excellent lime. The first opening was made adjacent to the spring, where the limestone is of a beautiful white color and is highly crystaline. Strata marks are indicated by light brown streaks containing mica. These streaks resist the action of the weather, and stand out in relief where the limestone is worn away. The wall rock of the bed is mica slate, but its boundaries have not yet been fully disclosed.

The second opening, a few rods distant, exhibits a regular bed of limestone, shaded slightly with blue, like that of Thomaston in Maine. It is included in mica slate, the strata of

which run N. 57° E., S. 57° W., and dip N. W. 60 degrees. The limestone measured at right angles to its direction, is 23 feet 4 inches wide.

The third opening was made in a pasture, and discloses the other extremity of the bed first dscribed. The whole width of this limestone is 400 feet, and its observed length is about 800 feet, but it is evident that it runs with the strata to a much greater distance and will probably be found to continue southwestward, forming a bed several miles in length.

This locality is of inestimable value to the State, saving a vast outlay for foreign lime; while it is evident from the analysis of the rock, that Haverhill lime will prove to be of a superior quality. (See chemical analysis of this limestone.)

Bath. From Haverhill corner to Bath, we observed the mica slate rocks in regular strata, which dip to the southeastward, and run northeast and southwest.

Two dykes of greenstone trap intersect the strata and alter the texture of the rock. In one place we observed the mica slate possessing strong magnetism with polarity, so as to reverse the compass needle. This was probably owing to the presence of minute grains of magnetic pyrites in the rock. In Bath, near the bridge, occurs a hard flinty slate passing into mica slate. It is evidently an altered rock. Several specimens of galena or sulphuret of lead, from the town farm, were presented to me for examination On cupelling a fragment of this galena, it was found to contain a small proportion of silver, but it would not be worth extracting, unless very large quantities of the ore could be obtained. Pyritiferous slate also occurs, but it does not appear to be sufficiently rich for the economical manufacture of alum.

The slate containing this sulphuret of iron, has been mistaken for the shale of the coal formation, and attempts were formerly made to discover coal in it, but of course unsuccessfully.

Brick clay is abundant in Bath, and extensive yards exist for the manufacture of bricks. I was informed that some of the clay beds would not make brick of good quality, and on examining them, ascertained that they contained a small proportion of carbonate of lime, but not sufficient to entitle the clay to rank as a calcareous marl. The calciferous clay occurs in thin seams, and can be distinguished readily by pouring a little muriatic acid upon the clay, when effervescence will take place, owing to the decomposition of the carbonate of lime by the acid and the disengagement of its carbonic acid gas.

I was informed of the existence of some small veins of iron and lead ores in Landaff, but was unable at that time to visit them. Specimens were obtained and have been analyzed in my laboratory. (See reports of analyses of minerals.)

The remainder of this section was explored by my assistants, who present the following report.

Geology and Topography of the northern corner of the State, by Messrs. Whitney and Williams.

The principal object in our short excursion to the Indian Stream settlement, and the country lying near the Magalloway, was to procure the necessary geological information

for the map to be published in the final report, and also to obtain what topographical information we could with regard to the heights of the mountains, courses of the rivers, and nature of the soil, since but little has been done, with any degree of accuracy, in that far removed section of the State.

Besides the usual difficulties attendant on such investigations in the woods, we were obliged to contend with a severe storm of rain and snow, which for twenty-two days continued to impede our progress.

The rocks of the section extending from Haverhill north, are almost entirely mica slate, often much contorted and filled with quartz veins, with occasional veins of injected granite, and it is not till we arrive at Stewartstown that we find the first signs of the clay slate, in numerous boulders, scattered over the tops of the high hills in that vicinity. The character of the soil then undergoes a marked change, becoming more retentive, and is peculiarly adapted to the culture of wheat, as we were assured by the intelligent farmers in that vicinity.

The surface of the vicinity of Stewartstown is composed almost entirely of diluvial detritus, brought from the north, which is piled up in hills, some of them of considerable elevation. The materials here accumulated have evidently been brought, in a finely divided state, from the clay slate and limestone beds which extend across the extreme north of the State and the adjacent regions of Canada, since no such rock exists in place for a great distance to the south.

South Hill, in Stewartstown, is, from our observations, about 2000 feet above the sea level.

The road from Stewartstown to the Indian Stream settlement, at the outlet of Connecticut lake, is almost impassable for wagons. This village, which is the most northerly inhabited place in New Hampshire, may consist of a dozen houses. The whole Indian Stream settlement, so called, comprises 315 persons, according to the last census. The falls of the Connecticut, at the outlet of the lake, furnish excellent water power, on which a saw mill is already built. The shores of this lake and the country adjoining are gently undulating. Camel's Rump, rising in the N. E., is the only high mountain seen from this point. Connecticut lake is about 1624 feet above the level of the sea.

The descent from the 2d Lake, as it is commonly called, to the first or largest Connecticut lake, is rapid. The course of the river, which is here hardly more than a small brook, is among large boulders of granite and clay slate, but no where are the rocks to be seen in place.

After crossing the second lake, we continued our march eastward over the range of hills which separate the waters flowing into the Magalloway from those which empty into the Connecticut. The highest point observed by us was about 2130 feet above the sea level.

From the 2d lake to the State line we suppose to be about 5 1-2 miles. After meeting with the State line, we continued to follow it, till, at a distance of about 5 miles from our camp, we arrived at the base of Camel's Rump mountain. Here we lost all traces of the line, which is very indistinctly spotted, and evidently has not been touched for many years. After spending some time in searching for the point where the line must have crossed the mountain, we gave it up and ascended to the summit, where we pitched our

tent. Here we remained for two days during one of the violent storms so common in this elevated region, which borders on the high table land of Canada. The last day being clear, and the barometer having risen, apparently, to its usual height, we have calculated, from the observations, the approximate height of the mountain at 3615 feet above the sea level. This, it will be seen, is one of the highest mountains in the State next to the White mountain range. Its geological character is peculiar. The specimens which we obtained from various parts of the mountain, from the rock in place, consisted of amorphous masses of hornstone, of various hues of color, from a light apple green to almost black. The mountain is covered with a low and tangled undergrowth, with stunted fir-balsams and spruce. We regret that, owing to foul weather and the exhausted state of our stock of provisions, our observations were not sufficiently extensive to determine whether this singular rock was erupted from below in a state of fusion, or was altered from clay slate, or whether its peculiar character is owing to large masses of underlying trap rock.

It is not probable that this mountain was ever before ascended by white men, for, though we searched diligently, we were unable to find any marks of former visitations, such as spotted trees or bushed paths. But, although the ascent was difficult, we were amply repaid by the magnificent extent of the view which was displayed before us, as the veil of clouds gradually rolled away before the wind. In the north, a series of high hills stretching beyond each other for five or ten miles, divide the waters flowing into the St. Lawrence from those of the Magalloway and Connecticut, beyond which, as far as the eye could reach, lay the extended table lands of Canada, unbroken by any abrupt elevation—to the east, the lofty granite ranges of Maine, Mt. Bigelow and Mt. Abraham—farther south, the numerous large lakes near Umbagog and the Diamond hills; while in the farthest distance were seen the lofty peaks of the White mountains; and to the west lay the lakes and tributary streams of the Connecticut, and the rolling ranges of the Green mountains.

As our stock of provisions was entirely exhausted, we were obliged to descend the mountain and return to our camp, without visiting the monument which marks the boundary between Maine, New Hampshire and Canada, intending to return after obtaining a further supply of provisions, in order to explore the Magalloway to its sources.

In this intention we were disappointed by continued and severe storms, and the extremely low water in the river, which rendered it impossible for our canoe to ascend.

The width of the Magalloway at the most northerly point where we saw it, which could not have been more than four or five miles from the monument, as laid down on the map of the State by Carrigain, seemed to confirm the opinion of Dr. Stephenson, who, in his description of this section, in Dr. Jackson's third annual report on the geology of Maine, declares that the boundary line is several miles too far south; or, in other words, that the water-shed lines between the sources of the Magalloway and the Chaudier, have not been ascertained with sufficient accuracy.

The examination of the country adjacent to the river presented little of interest to the geologist. The banks of the river consist mostly of an alluvial deposit, raised only a few feet from its level, and stretching back several miles on either side. Rarely are the rocks seen in place. The shores of Parmachene lake are lined with round pebbles of granite,

jasper and hornstone, except at the southern point, where the blocks of granite are very large and angular, and piled together in the greatest confusion. Talcose slate occurs in place on the river.

At the point where the river enters within the limits of New Hampshire, the rocks are uniformly granite, which extend from near Capt. Wilson's, in Township No. 5, 2d range in Maine, to the north of Clear stream, where we left our canoe, in order to cross on foot and return to Colebrook, there being a tolerable road from Capt. Bragg's, in Errol, through the Dixville notch to Colebrook.

This notch may be regarded as one of the most remarkable exhibitions of natural scenery in the State, perhaps even surpassing the famous notch of the White mountains in picturesque grandeur.

A natural defile through the high mountains, which extend in a general north and south direction through the town of Dixville, affords admirable facilities for the construction of a new road to Portland, which may become of importance to this part of the country.*

The angular and precipitous appearance of the mica slate rocks, rising hundreds of feet almost perpendicularly on either side, is strikingly different from the rounded and water worn appearance of most of the primitive rocks throughout the northern part of the United States, and seems to come nearer to the scenery of the Alps than any thing else in New England. (See view of Dixville notch.) It is evident that so interesting a spot as this must, when known, draw thither a portion, at least, of the numerous visitants to the picturesque scenery of the State.

Although it rained severely when we arrived at Colebrook, which we regarded as the continuation of the storm by which we had been so long followed, we were surprised to learn that nearly the whole of the month had been clear and pleasant throughout the whole of this part of the State.

In conclusion, we would remark that the geological and topographical information which we obtained, will appear on the map to be appended to the final report of the State geologist. Specimens of the principal rocks, also, have been deposited in the State cabinet.

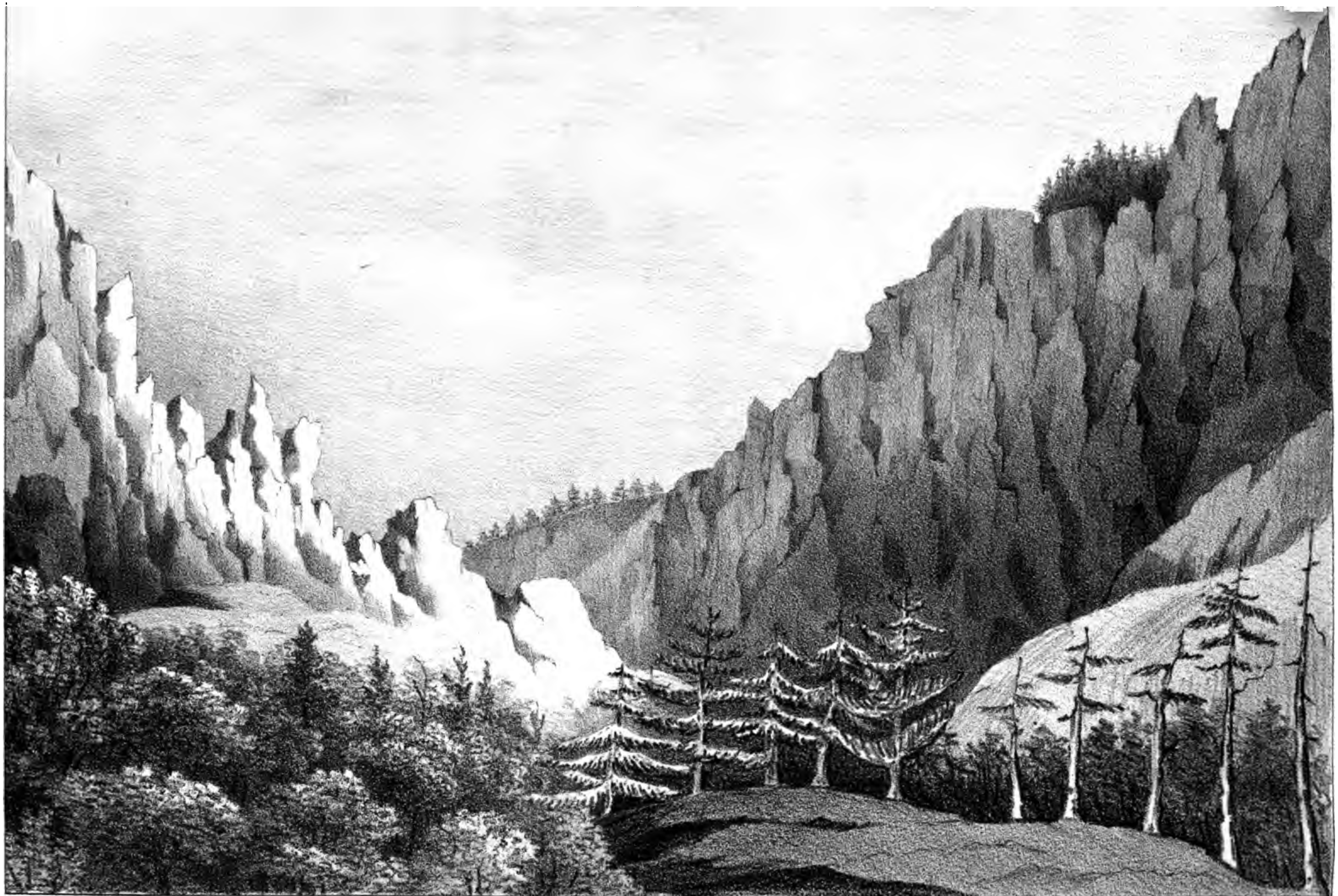
Section from Concord to Wakefield, by Messrs. Whitney and Williams.

The section from Concord to Wakefield is one of uniform geological character, and possesses little interest.

Commencing at the alluvion of the river Merrimack, and rising by a sharp ascent to the level of the sandy diluvion, which extends for miles on each side of the river, the underlying rock, granite, is seen only once in place during the first seven miles. About 1-2 mile from the village of Loudon, granite occurs *in situ*, and continues to the eastern line of the State. Near Loudon, and for several miles beyond, it is crossed by occasional beds of mica slate, having a general N. E. and S. W. direction, and dipping to the S. E.

The granite rocks in this vicinity are found, when freshly uncovered, to be covered with the marks of diluvial agency, and, as would be expected in a section of the country where such immense masses of diluvial detritus are collected, they are often deep and very

*This road has since been constructed and proves to be a valuable thoroughfare for teams going to Portland.



J D Whitney del.

DIXVILLE NOTCH

distinct. Their direction near the village of Loudon, varied from 12° to 25° west of north. Near the academy in Gilmanton, they run N. 27° W. Gilmanton is covered by a series of high diluvial hills, evidently the detritus of granite rocks brought from the northward.

The soil in many parts of the town is very fertile, and has been brought to a high state of cultivation, and no part of the State presents a more pleasing and picturesque appearance to the eye of the agriculturist. The simple minerals and ores contained in the granite of this region, are few in number and destitute of interest. Quartz crystals, of considerable size, are said to be found near Shellcamp pond. A considerable quantity of bog iron ore, of good quality, was formerly obtained from Lougee pond, in the S. E. corner of the town of Gilmanton. It was taken from the bed of the lake by means of long tongs, and carried to the Iron Works village to be smelted. The quantity of ore was evidently inadequate to supply a furnace for any length of time.

From Gilmanton, through the remaining part of this sectional line, the rocks are uniformly granite, covered, as usual, with huge boulders of granite and mica slate.

Great Moose mountain, which forms the dividing line between Brookfield and Middleton, consists entirely of granite, and is elevated 1404 feet above the sea.

Section from Wakefield to Haverhill, and examination of the country adjacent to Lake Winnipissiogee, by Messrs. Whitney and Williams.

From Wakefield to Moultonborough the underlying rock is granite, covered with boulders of granite and masses of diluvial granitic sand. Some of the boulders are of enormous size. Near the house of Mr. Ambrose, in Ossipee, is a collection of loose masses of granite, one of which measured forty-three feet in length, seventeen feet high and twenty-one feet wide. A ledge of hornblende rock, of limited extent, crosses the road near the village of Wakefield.

In Moultonborough, the character of the rocks begins to change. Red Hill, which rises about 2,000 feet above the level of the sea, is composed of a beautiful sienite, in which the felspar is of an ash grey color, when freshly exposed. Near the summit of the mountain, where the ledges of rock are exposed to the action of the air, it is of a reddish hue. The mountain is crossed at about one-third of its height by a large dyke of porphyritic trap, whose general direction is about N. 30° W. Being covered with soil, it is impossible to trace its limits. The hornblende of the sienite is in some instances well crystalized, so as to afford very good cabinet specimens. Near the house of Mr. Cook, about half way from the base to the summit, occurs a deposit of bog iron ore. It is only a few inches thick, and of limited extent. From it a crowbar has been manufactured. Near this spot small quantities of iron pyrites have been found, also black tourmaline, which has been mistaken for coal.

This mountain is covered with soil and is wooded nearly to the summit. It owes its name to the circumstance of the leaves uva ursa with which it is covered, changing to a brilliant red in the autumn.

Great numbers of visitors ascend this mountain, attracted by the unrivalled beauty of the scenery of the country bordering on lakes Winnipissiogee and Squam. On a clear

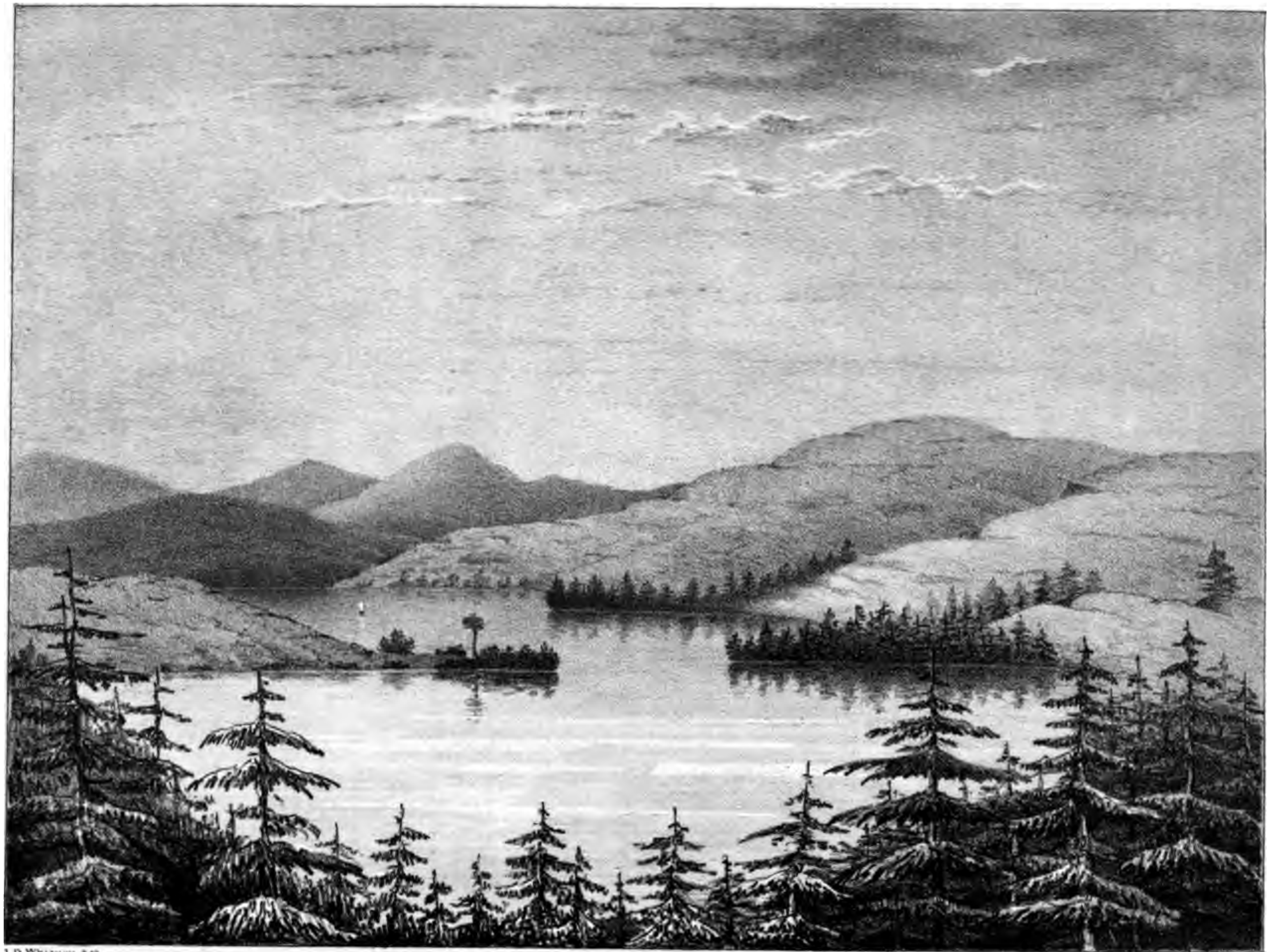
day, the view from its summit is of great extent. The lofty peaks of Kearsarge, Sandwich, Whiteface, Conway, Pequaquet and Ossipee mountains, seem to enclose, in an amphitheatre, the lakes with their numerous picturesque islands, covered with the dark foliage of the spruce and pine, forming the most beautiful mountain view which this country affords. (See view of Winnipissiogee lake.)

The shores of lake Winnipissiogee are covered with angular fragments of granite and granitic sand. A beautiful amethyst sand is found abundantly on the shores of Long island. The number of islands in this lake is very great, and several of them have become quite well known for the large crops which skillful cultivation has produced upon them. These will be noticed in the agricultural part of the report. Rattlesnake island is elevated from 400 to 500 feet above the lake, and presents from its summit a fine view of the surrounding islands. Their geological character is quite uniform, being composed of angular fragments of granite piled on ledges of the same rock, which are often cut through by veins of injected trap and granite.

Ossipee mountain, in Ossipee, about three or four miles from the eastern shore of the lake, is composed of several distinct peaks. The most lofty, which is elevated 2361 feet above the sea level, is well wooded, and covered with larch, spruce and birch to the summit. The rock is gneiss, covered with numerous fragments of trap brought from the most northern peak, which is an isolated bare precipitous range of bluish greenstone trap. This rock has been mistaken for iron ore and for limestone, neither of which minerals occur there. Near the foot of the mountain is a beautiful little cascade, which attracts numerous visitors to the mountain; also, a spring slightly impregnated with sulphydric acid gas, which has attained some celebrity among the inhabitants as a remedy for cutaneous diseases.

The greenstone trap peak of Ossipee seems to be connected with a series of dykes of greater or less extent, occurring in numerous places in the adjacent country. A series of them cross the road from Centre Harbor to Tamworth, nearly on a line between Ossipee and Red mountains. They are very numerous, and measure from one to three or four feet in thickness. Their general direction is N. 60° or 70° W. Trap dykes are also very numerous on the margin of Squam lake, varying from one inch to ten feet in width, running nearly E. and W. About six miles north from Centre Harbor occurs a dyke cutting through granite, and is about ten feet in width. It is porphyritic with flesh colored crystals of felspar. These dykes are very distinctly marked from the surface of the granite including them. They have been worn and polished by the action of the diluvial currents, so that a level and smooth surface comprising many thousand square feet, lies entirely bare of soil.

Gunstock mountain, on the southwestern shore of this lake, is made up of three distinct peaks. The most northerly is the highest, being about 1969 feet above the lake, and 2447 feet above the sea. The westerly peak, according to Dr. Jackson's observations, is 1561 feet above the lake, and 2039 feet above the sea. On its declivity occurs a vein of magnetic oxide of iron, which is included in sienite rock, and is irregular in its dimensions, varying from a few inches to two feet in width. The ore is remarkably magnetic, with strong polarity, especially near the surface, the interior not being so strongly polarized. Large quantities of this ore are now lying loose upon the ground, and will furnish an abundance of cabinet specimens; there is not an adequate supply for a furnace.



J. D. Whitney del.

VIEW ON LAKE WINNEPISSEOGEE.

The most southerly peak affords a magnificent view of lake Winnipissiogee and its islands, with the surrounding mountains. Large dykes of trap occur on this mountain. It was supposed that limestone had been found there, but examination has not confirmed the opinion.

From Meredith to Centre Harbor, the rock in place is porphyritic granite, often traversed by beds and veins of fine grained, dark colored granite and trap. Some specimens of the porphyritic granite, in which the crystals of felspar are flesh colored, are very beautiful.

Boulders of this rock are scattered in great numbers to the south of their native bed. They have been carried from eight to ten miles by the action of the diluvial currents. From Centre Harbor to Plymouth, the rocks in place are porphyritic granite, traversed by occasional limited beds of mica slate. In Plymouth mica slate occurs, and continues to near the line of Wentworth, where the granite replaces it. Near Rumney line, at the base of Carr's mountain, the mica slate runs N. 35° E., and dips nearly vertical. This rock splits very smoothly, and might be quarried to any extent.

Carr's mountain, which is one of the most lofty elevations in this part of the State, being about 3381 feet above the sea level, is composed of granite overlying mica slate. From the vertical dip of this rock at its base, it would seem highly probable that the granite had been erupted through it, forming a cap upon its summit.

Examination of the country from Haverhill to the White Mountains.

Having completed the measurement of our great longitudinal section, which will be represented hereafter by a colored engraving, we made a rapid reconnoisance of the country from Haverhill to the White Mountains, by the way of Lisbon and Franconia, examining particularly the limestones and iron ores which are found in the last mentioned towns. From Bath to Franconia the mica slate rocks predominate, and in Lisbon these rocks contain an infinity of beautifully crystalized staurotides and garnets, which, on the shores of Mink pond, have been detached from the rock by decomposition, so as to form the principal pebbles on its beach. This locality will prove interesting to mineralogists, who can readily obtain as many separate crystals of staurotide as they desire, by visiting the shores of the pond.

The limestones of Lisbon are contained between walls of mica slate, and quarries have long been wrought in several places for the supply of lime. The principal quarries are owned and wrought by Owen Bronson, Thomas Priest, David Priest and Uriah Oakes. The bed at T. Priest's quarry runs N. 69° E., S. 69° W., and dips to the N. W. 70°. It is 13 feet wide, and has been opened to the depth of 60 feet, and 300 feet in length. Bronson's quarry is a part of the same bed, and is situated to the S. W. The limestone is crystaline, and of a greyish white color, and is said to make good lime. (See analysis.) David Priest's quarry is situated a mile and a half northeastward from this locality.

From David Priest's quarry we took the bearings of the other openings, where limestone had been obtained. T. Priest's quarry bears S. 71° W.—Uriah Oakes' N. 81° E. From these bearings it will appear that there must be several distinct beds of limestone, running parallel with each other, or the strata may curve where they may not be observed on account of the superficial covering of soil.

I shall give the statistical information obtained at these quarries, in another part of this report, where the composition of the limestone will also be stated.

FRANCONIA. This town owes its rise and prosperity to the discovery and working of a rich vein of granular magnetic iron ore, which exists within the present limits of the town of Lisbon, at its southeastern corner. The iron ore is a vein from 3 1-2 to 4 feet wide, included in granite rocks. The course of the vein is N. 30° E., S. 30° W., and its dip is to the southeast 70° or 80°. It has been opened and wrought 40 rods in length, and 144 feet in depth. The ore is blasted out by the workmen, employed by a contractor who supplies the Franconia furnace. The mine is wrought open to daylight, and is but partially covered to keep out the rain.

On measuring the direction of this vein, it was evident that it extended into the valley below, and on searching on the hill side in that direction it was readily discovered.

It is probable that openings will be made there, and a gallery will then be cut into the hill. Formerly much expense was incurred by unskillful searching for additional veins of iron ore, many old drifts being shown us by the present skillful director, Captain Putnam, where a vast deal of labor and expense had been wasted in fruitless search. In one place there was a gallery 120 feet long, cut in the solid granite, without any indications of a vein of iron ore. Near this another vein was cut in a northerly direction, for the distance of 71 feet, also without discovering any ore.

There are some very curious irregularities in the courses of the iron ore veins, which probably embarrassed the first miners who worked at this place. One of the veins on the hill forms a large curve, and is nipped out at one extremity. When first opened it was 6 feet wide, but it rapidly diminished in power to 1 1-2 feet wide as it entered the rock. Many curious and remarkable caverns have been formed in the rocky sides of the hill by these mining excavations.

Numerous interesting minerals have also been brought to light, and may be found among the rejected masses which have been blasted out. The most abundant and interesting minerals are a brilliant deep brownish red manganesian garnet, crystalized and granular epidote, prismatic and bladed crystals of hornblende, rhombic dodecahedral crystals of magnetic iron ore, with striæ indicating their origin from the octahedral primary form.

These minerals have long been familiar to most of the mineralogists of the country, since they have been extensively distributed by exchanges. Every season many mineralogists journey to Franconia for the purpose of collecting specimens which are abundantly obtained at the mines.

Having measured the extent of the iron vein so far as it is opened, and procured a good collection of specimens for analysis and for the State Cabinet, we returned to the village of Franconia, examined the furnaces, and collected some valuable statistical matter, furnished through the politeness of the agent. (See another part of this report for chemical analysis of the ore, and for statistical information respecting the iron works.)

On the estate of Mr. Horace Brooks occur several veins of copper pyrites, included in mica slate rocks, and associated with veins of quartz. These veins were examined, and were found too narrow for profitable mining, their width being rarely more than 6 or 8 in-

ches, while the gangue or veinstone is exceedingly hard. Fine cabinet specimens, nevertheless, may be obtained without much trouble.

The scenery of the Franconia Notch, and the view from the summit of Mount La Fayette, have justly been admired by travelers.

Although less imposing than the wild magnificence of the White Mountain Notch, it still may present attractions of another character which will prove equally interesting to the curious. The Basin, Flume and the Profile Mountain are the usual scenes admired by travelers who visit this place.

The Basin is a deep excavation in granite, which has been formed by the continal action of the falling waters of the Pemmasawasset, aided by the whirling and grinding action of boulders of rocks swept into the cavity by the stream. The diameter of this rocky basin is about 30 by 40 feet, and its depth appears to be in such proportion as to form a deep bowl, which is always filled to the brim with the most pellucid and cold water. On one side the rocks jut over the brim of the basin, forming a pretty grotto beneath, while the embankment, covered with green moss and wood flowers, presents a pleasant contrast to the foaming cascade, which rushes down the broken surface of the rocks.

The Flume is situated 3-4 of a mile from the main road, on the left hand as you go from Franconia. A narrow path through the woods conducts the traveler to the spot. On the way he must, however, cross over several small streams on fallen trees, which there are the only bridges, and will walk in a shallow sheet of water, which rushes swiftly down a smooth inclined plane of granite. It is, therefore, advisable always to proceed on foot.

The Flume is a deep chasm, having mural precipices of granite on each side, while a mountain torrent rushes through its midst, falling over precipitous crags and loose masses of rock. During the freshets of the spring season and in early summer, it is not practicable to walk in the bed of the flume, but in the driest season of the year there is but little water in it, and the bottom of the ravine affords a good footpath.

The direction of this rocky fissure is N. 80° E., and it appears to have resulted, not from the abrasion of the rocks by the action of running water, but to have been produced originally by a fracture of the uplifted rocks.

The walls of the chasm on either hand exhibit proofs in favor of this opinion, for they are not water worn, but present surfaces of fracture, and the projecting ledges on each side are still comparatively sharp and well defined in their outlines.

One of the most remarkable objects in the Flume is an immense rounded block of granite, which hangs over head, supported merely by small surfaces of contact against its sides. It appears to the traveler looking at it from below, as if ready to fall upon him.

The trunk of a fallen tree crosses the top of the ravine, and affords a natural bridge to adventurous persons who rejoice in the feat of crossing so narrow a foot path suspended high in air. No one unaccustomed to feats of the kind should attempt so unnecessary and dangerous a pass.

I have been told by persons who have seen the Flume when nearly free from water, that near its upper part a dyke of trap rock may be seen. A few fragments or smooth boulders of that rock were observed in its channel, but, although my assistants waded throughout

its entire extent, they saw no dyke. If small, it may have been covered by deep running water. (See lithographic view of the Flume.)

The most remarkable object seen from the Notch is the Profile called the Old Man of the Mountain. This may be seen at a point indicated by a guide board on the road. As the traveler reaches this point, he is directed by the guide board to look on the opposite side of the way, where he discovers a stern visage of gigantic proportions on the brow of a rocky mountain, looking boldly upward.

This remarkable object was first discovered about 40 years ago, when laying out the road. Had it been known to the aborigines, I doubt not it would have been an object of superstitious worship. (See view of the Old Man of the Mountain, Franconia.)

Mount La Fayette is a lofty conical mountain of granite, situated to the southeastward of the village of Franconia. Although not so elevated as Mount Washington, it presents an equally interesting view from its summit, and is frequently ascended by travelers.

In order to measure its altitude and its latitude, and place on the map, we ascended to its summit, carrying with us a sextant, artificial horizon, barometer, and Messiat compass, and made a series of observations to effect our object.

A rude footpath has been cleared for part of the way up the side of the mountain, but for a considerable distance we had to scramble over fallen trees and rocks. Emerging from a forest of small spruce trees, we next came to ledges and detached rocks of granite, the loose blocks of which are generally angular, and do not appear to have been worn by the action of water. They are similar to the rock composing the ledges of the mountain, and therefore cannot be considered as drifted rocks.

The vegetation near the top of the mountain is similar to that upon Mount Washington. Blueberries, mountain cranberries and harebells abound amid the crannies of the rocks, but no forest trees grow near the summit. From the highest peak of this mountain Mount Washington bears N. 80° E., Franconia village N. 35° W., Moosehillock S. 54 E. The ranges of mountains seen to the east, appear to be parallel ranges running north and south.

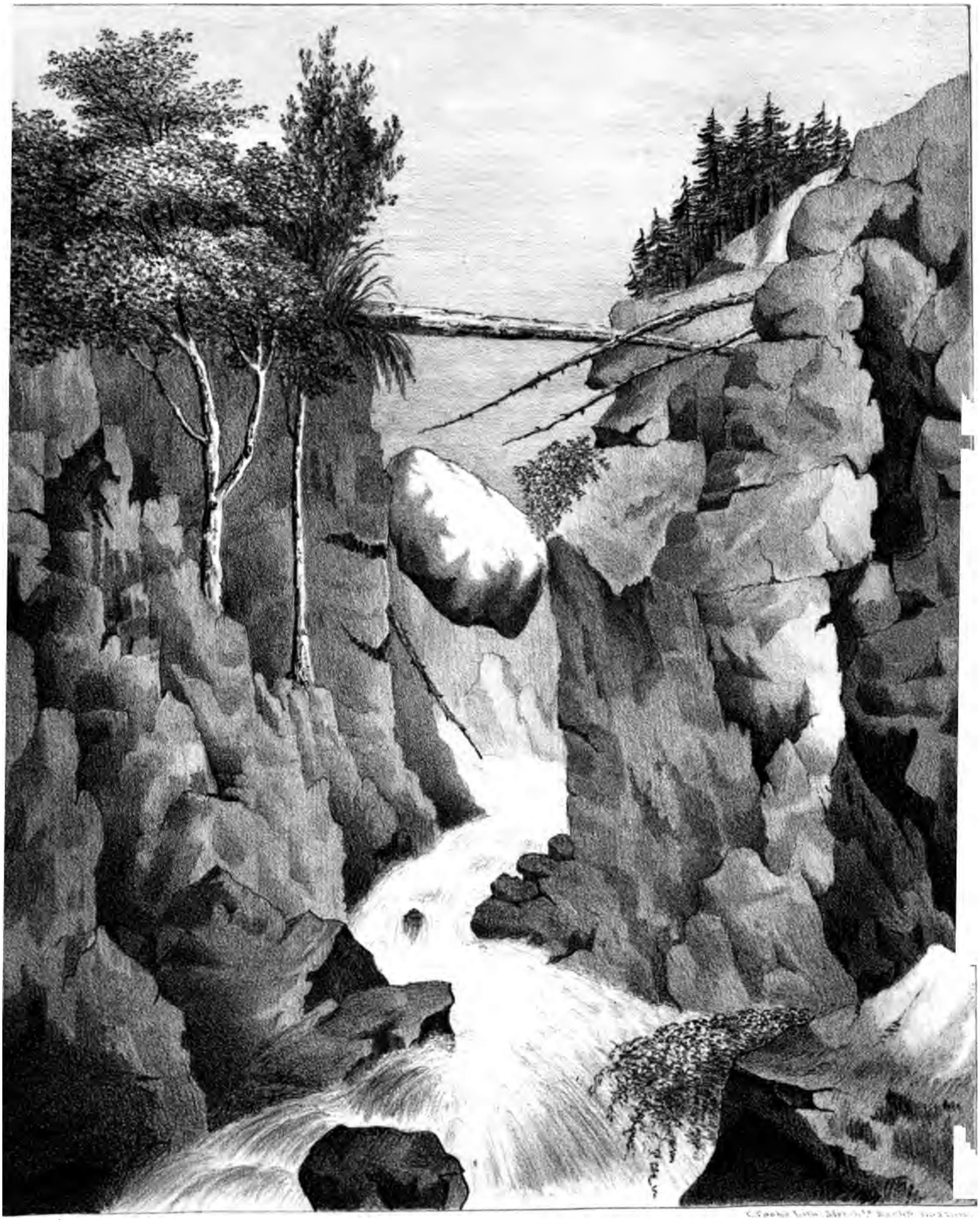
By a comparison of barometrical observations, made at Franconia, Portsmouth, and upon the summit of Mount La Fayette, we were enabled to ascertain by calculation the height of the mountain above the level of the sea, which was found to be 5067 feet.

By a meridional observation of the sun, its latitude is N. 44° 8′ 59″ 4.

No minerals of any importance were found in the granite rocks composing the mass of this mountain, but a very good view of the contour of the surrounding country may be obtained, and the lovers of the picturesque will always find enough to repay them for the labor of ascending to its summit.

From Franconia we passed through Bethlehem to the notch of the White mountains, observing no rocks excepting granite and gneiss, the surfaces of which were occasionally marked by drift striæ. Each hill on our way was measured barometrically, so that we shall be enabled to draw a sectional profile of the route. At Mr. T. J. Crawford's we made all the requisite preparations for measuring the altitudes and latitudes of Mount Washington and the adjacent mountains, which we proposed to examine.

By meridional observation of the sun at T. J. Crawford's the latitude of that place is N. 44° 12′ 53″, and its elevation above the sea level is 1829 feet.



FLUME FRANCONIA.

A horsepath had just been completed to the summit of the mountain, and we were enabled easily to make our ascent, carrying in safety all the instruments for the observations which we proposed to make.

Mr. Abel Crawford, the veteran guide of the mountain, accompanied us, and leading our party, was the first man who ever rode to the summit of Mount Washington.

Before leaving the Notch House, barometrical observations were taken, and on our ascent they were repeated with two instruments upon every eminence over which we passed. Since it was intended to leave two of my assistants to make observations upon the summit of the mountain, while the remainder of our party returned with one of the instruments, we provided ourselves with camp equipage, and Messrs. Williams and Baker volunteered to remain there through the night, for the purpose of observing the barometer at the summit, while we took simultaneous observations below. Being duly provided with sextant, artificial horizon, barometers, thermometers, and our usual geological instruments, we set out from Mr. Crawford's at 7 A. M.

Entering a narrow footpath leading through the forest, we rode to the summit of Mount Clinton, a bald mountain having no other forest trees upon it save a few stunted and dead spruces, which were killed by fire. At this place barometrical observations were taken, and the spot was marked for repetition of the observations on our descent. From this place we proceeded to Mount Pleasant, where similar observations were taken; then we passed to Mount Franklin, where the same operations were performed.

On Mount Franklin all traces of vegetation, excepting plants of an Alpine character, disappear.

The rocks consist entirely of granite and gneiss, with occasional veins of quartz.

Several small ponds and springs occur near this spot, and travelers generally stop awhile there to refresh themselves before ascending to the summit of Mount Washington, which is in full view, and presents its rough and rocky escarpments. At 11 3-4, A. M., we reached the summit of Mount Washington on horseback, a feat quite novel, this being the first time that it has been effected.

Travelers should thank the Crawford family for having made this ascent so easy and agreeable, for now any person who knows how to ride, may safely travel on horseback over their path to the very highest point in New England.

I doubt not that this circumstance will induce a greater number of persons to ascend the mountain.

Having reached the summit of Mount Washington, we allowed our horses to pick the dry, harsh, but sweet grasses which grow in the crevices of the rocks, and proceeded to make ready for our observations. By means of a mercurial horizon, and one of Gambey's sextants, I measured the latitude of the mountain by a meridional altitude of the sun, correcting by barometrical and thermometrical observations for the refraction.

By the observation we have calculated the latitude of the summit of Mount Washington to be N. 44° 16′ 34″ 48. By means of a series of barometrical and thermometrical observations, made for a period of twelve hours at a time, when the weather was remarkably favorable, and the atmospheric pressure was stationary throughout the State, as shown by other observations made at the same time, we have ascertained the height of Mount

Washington to be 6226 feet above the high water mark in Portsmouth harbor. Calculated by a series of observations, the height is 6228 feet, making but 2 feet difference in the elevation, and on single observations the difference is but 6 feet. We may, therefore, feel satisfied with the correctness of our result.

The geological features of Mount Washington possess but little interest, the rocks in place consisting of a coarse variety of mica slate, passing into gneiss, which contains a few crystals of black tourmaline and quartz. The cone of the mountain and its summit are covered with myriads of angular and flat blocks and slabs of mica slate, piled in confusion one upon the other. They are identical in nature with the rocks in place, and bear no marks of transportation or abrasion by the action of water.

On the declivity of the cone occurs a vein of milky and rose colored quartz, but it is not sufficiently high colored to form elegant specimens.

The geologist will be fully rewarded for his toil in ascending this mountain, by the magnificent and comprehensive view which may be obtained of the surrounding country. He will remark that the mountains are not grouped at random, but form regular ranges, running in definite directions coinciding with the axis of elevation.

To the southeastward three ranges of mountains are seen and appear to run N. N. E., while to the southwest the mountains run in a nearly north and south direction. The valleys are observed to be regularly continuous between the mountains. The whole country, so far as the eye can reach, is thickly clad with the primeval forest trees.

Having completed such observations as were deemed essential to our purpose, Mr. Whitney and myself descended with one of the barometers, taking observations at each spot where we had observed in the morning, Messrs. Williams and Baker remaining, meanwhile, on the summit of the mountain, engaged in making, hourly, similar observations with the instrument suspended at that spot. They were directed to camp near the summit of the mountain, and to commence their observations during the next day, while we were engaged in making observations below, at the Notch House.

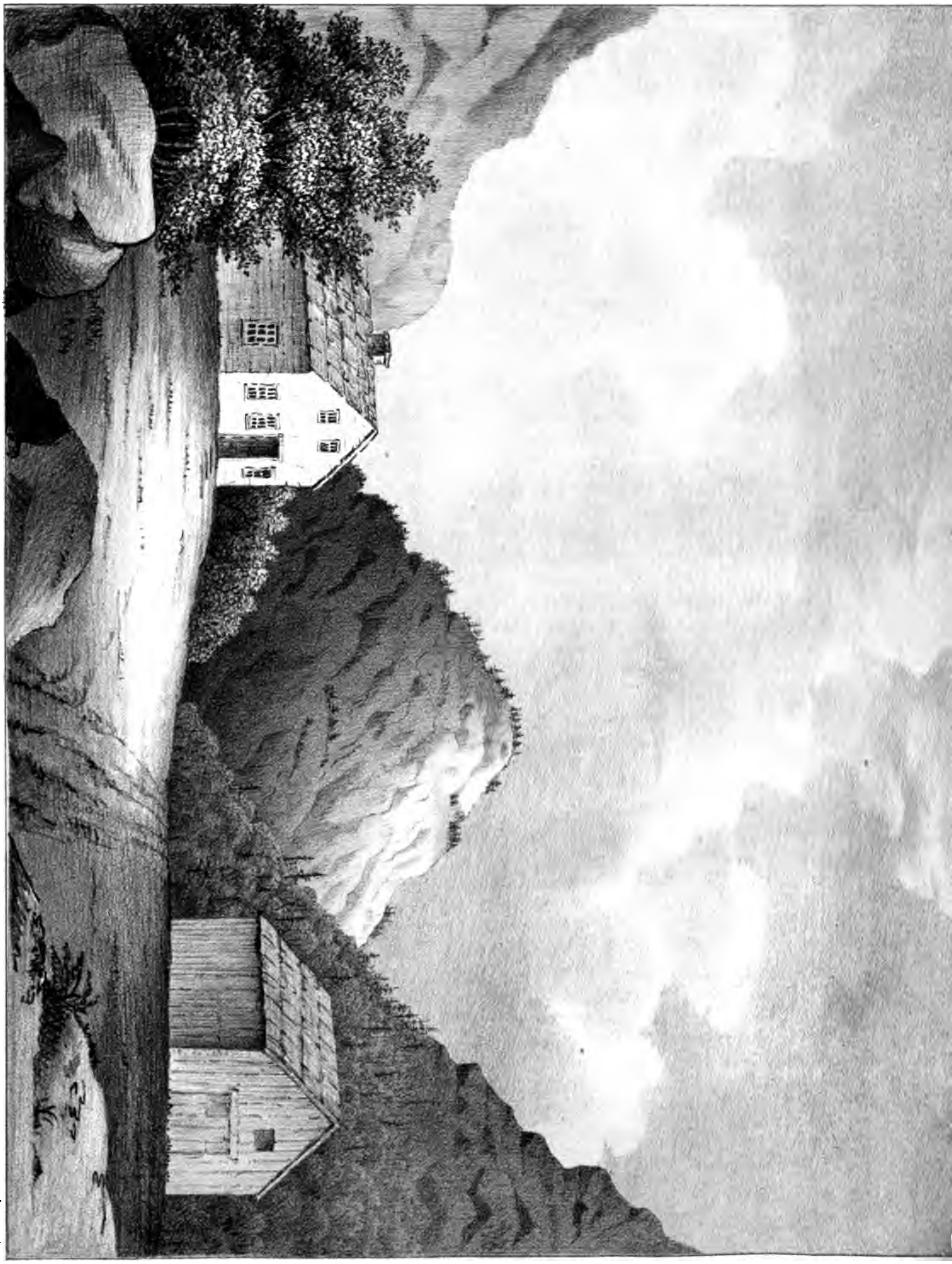
By taking a mean of a given number of barometrical and thermometrical observations, and calculating them as two sets, we are enabled to make a more accurate measurement than had before been effected; and by calculating the height of each separate station, and comparing the result with those obtained by the above mentioned method, we are enabled to prove the correctness of the work.

The height of the Notch House above the sea level was obtained in a similar manner, by comparing the observations made at Portsmouth with those made at T. J. Crawford's.

From the lofty peaks of the White mountains we proceeded to explore the ranges of a lower level, which form their outskirts or spurs. In the towns of Bartlett and Jackson occur several valuable ores, which I had partly explored on a former occasion.

The most important of these minerals is the iron ore which exists in inexhaustible quantities on Baldface mountain, between the rocky branch of the Saco and Ellis river in Bartlett, near the south line of the town of Jackson.

Baldface mountain is composed of granite, having a few dykes of greenstone trap cutting through its midst. The elevation at which the iron ore occurs is 1404 feet above



the rocky branch of the Saco, and about one mile distant. The slope of the mountain to the river is from 17° to 20°.

Since my first visit, which was made four years ago, some new openings have been made, for the purpose of discovering the boundaries of the veins of iron ore, and I had, therefore, a better opportunity of estimating the value of the ore.

One of the veins at the upper opening measures 37 feet in width in an east and west, and 16 feet in a north and south direction.

The second opening, 200 feet lower down the slope of the hill, exposes the ore maintaining the same width. Three hundred feet lower down, the vein is observed to narrow, and is but 10 feet wide, and 400 feet further down the width increases to 55 feet.

546 feet lower still there is a small opening or cave, 20 feet deep, where the ore narrows again.

On searching to the westward of this great vein, at the distance of 250 feet we soon discovered a new one, which appears to be of large dimensions, but we were unable to uncover it sufficiently to determine its width.

49 feet farther westward the soil is full of angular fragments of the ore, indicating another vein.

It is evident that this mountain is intersected by a great number of veins of excellent iron ore, and will furnish an inexhaustible supply for a furnace.

It is difficult, in the present condition of the mines, to ascertain the precise direction of the veins, since their walls are not exposed for a sufficient distance to furnish the requisite data; but the general course of the openings indicates the direction to be nearly N. 37° E., S. 37° W.

In the chemical department of this report will be stated the exact chemical composition of this ore. It may be proper here to remark that it is composed chiefly of the peroxide of iron, combined with a small proportion of the protoxide, and it contains a little oxide of manganese.

From the composition of the ore, we know that it will make excellent iron, and the best kind of steel. The presence of a small proportion of manganese favors the formation of a steel of very fine grain, suitable for cutlery. (See *Berzelius traite de Fer.*)

The mines are situated 30 miles from the town of Bridgeton, in Maine, where the canal affords a means of cheap transportation of the iron to Portland. A good road, regularly descending, leads to Bridgeton, and it is said to be practicable to shorten the distance about eight miles, by a slight change in its course. The country around the iron mines is thickly clad with hard wood, suitable for the manufacture of charcoal, which can be furnished at a very reasonable cost. There is reason to believe that these mines will soon be wrought, both for domestic use and for the supply of the Atlantic cities. It should be remembered, although iron made with charcoal costs more than the English iron, which is made with coke or bituminous coal, that it is vastly better for machinery, where a soft and pure iron is wanted.

A small quantity of bog iron ore has also been discovered in the town of Jackson, 5 miles north from Chesley's tavern, in the midst of the forest.

I examined the place, and found the quantity of iron ore too small to warrant the ex-

pense of digging it out of the bog. The peat which composes the principal part of the swamp is vastly more valuable for agricultural use.

Near the house of Captain J. Trickey occur several dykes of greenstone trap, which are so highly charged with carbonate of lime as to effervesce strongly with acids. On chemical examination, the rock was found too poor for burning into lime, but it will answer a useful purpose as a flux for the iron ore. Crystals of quartz forming handsome druses are found in the granite at the same place. Iron pyrites also occurs in disseminated crystals.

The trap dykes are very remarkable, and are worthy of a visit. They cut through strata of mica slate, gneiss, and a granite vein.

One of the dykes measures 50 feet in width, and exhibits at its junction those curious metamorphoses which are observed at their points of contact with other rocks.

Another dyke contains carbonate of lime in combination with the rock, and in the form of incrustations and in slender veins. In some places the limestone appears to have been converted into a compact chert, particularly at the junction of the rock with the mica slate walls. Where the pyritiferous mica slate decomposes, the surface is covered with a bright yellow powder, which is the peroxide and subsulphate of iron, mixed with the fine particles of decomposed rock.

Tin Ore. On a former occasion I had ascertained the existence of arsenical pyrites in the town of Jackson, and during the present visit it was thought proper to examine the vein in order to ascertain its extent and value. Having other localities to visit, I engaged Mr. Eastman to have a quantity of the ore blasted out, and when this was done, I visited the locality and examined it minutely. While searching for crystals of arsenical cobalt, I discovered a small vein of copper pyrites and crystals of oxide of tin. The mass of rock from which the tin was obtained, appeared to have formed a part of the rock including the arsenical pyrites, for it was traversed by the arsenical vein. The mass of tin ore was sharp angular, and had been freshly broken from the rock. Besides the crystalized tin ore, I also found the compact and the granular varieties intermixed in the mass.

The crystals of oxide of tin are thickly implanted and mixed with the matrix, so that the ore would prove workable, if a sufficiency could be obtained to supply a furnace. The oxide of tin had a deep hair brown color, and was regularly crystalized in the secondary or prismatic forms, with terminal planes like those from Cornwall. Some of the crystals have re-entering and salient angles, or are hemitropic. A figure will be given in this report, representing the measured angles and form of the mineral.

From the external characters I had no doubt that the ore was one of tin, and in the evening of the same day I proved it by reducing the tin to its metallic state, and then converted it by means of nitric acid into the insoluble white oxide of tin, known to chemists under the name of stannic acid. Since that time I have reduced a quantity of the ore to its metallic state, and have deposited a piece of it in the State Cabinet at Concord.

This discoverry is regarded as one of no small importance, for, although a few minute grains of oxide of tin are said to have been previously found in New England, this may be considered as the first vein of tin ore that has been discovered in the United States. By washing the ore in a manner similar to that used in large works, a portion of the rock is removed, and the ore then yields on the average 30 per cent. of pure tin, and when more

thoroughly cleansed it gave 50 per cent. It is highly probable, since oxide of tin has not the slightest metallic appearance, but appears like a brownish colored stone, that it has been overlooked by people who are not familiar with minerals.

If, indeed, large masses were found, the weight of the ore might lead some persons to suspect that it contained a metal; but this is very rarely the case, since the ore is either found in scattered crystals or in small rounded pebbles, which latter are known in commerce under the names of stream and wood tin. The crystals found on Mr. Eastman's land, are rarely more than 1-4 of an inch in length, and one-sixth of an inch in diameter, but the fine granular tin ore abounds in the same mass.

I should advise the people who are interested in the mine, to blast out the arsenic ore, which will sell for $40 per ton if well selected. This will repay the expense of mining, and by opening the arsenic vein it is probable that more tin ore will be found, since it occurs beside that ore, forming one of the walls of the vein. The arsenical pyrites is used for making arseniate of potash, which is employed in the manufacture of scheeles green, and in calico printing. The ore above noticed yields on distillation from 30 to 40 per cent. of pure metallic arsenic. It contains about 60 per cent., but a portion of the arsenic remains combined with the iron, so that it is not all obtained. By deflagration with nitre, a much larger proportion of the arsenic may be extracted in the form of arseniate of potash. (See analysis and assay of this ore.)

Investing the ore and in its cavities there frequently occurs a lemon yellow powder, which is arseniate of iron or scorodite.

Arsenical pyrites is said to be a rare mineral in Europe, but in this country it is very abundant, especially in the states of Maine, New Hampshire and Massachusetts. It may in several places be economically wrought for the manufacture of arseniate of potash, and for metallic arsenic, which is required for making lead granulate in shot manufactories. The market is at present supplied by the furnaces of Germany, where the arsenical ores are roasted, and the arsenic is sublimed in the state of white oxide or arsenious acid.

Metallic arsenic is also used in making speculum metal for astronomical telescopes, but the demand for the pure metal for that purpose is quite limited. Recently the introduction of arsenical compounds in calico printing works, has caused a great increase in the demand for its salts and oxide.

While engaged in exploring the geological resources of Jackson, many citizens of that town freely tendered their services, and aided us in the labor. Our thanks are due to them for their spirited exertions in behalf of the survey.

When we had examined the rocks and the most important minerals in that town, we proceeded to Bartlett, and ascended Pequaquet mountain, where it was stated that some expectations had been entertained of finding coal and roofing slate. The result of our examination proved that the rocks on this mountain do not belong to the coal formation, and that no good roofing slate can be obtained there.

On ascending the mountain on its southeastern side, we came first to a coarse variety of granite, consisting of felspar and quartz, without any mica, which is overlaid by a breccia of granite and argillaceous slate, above which rest the regular strata of argillaceous slate,

which run N. 75° E., S. 75° W., and dip to the N. N. W. 30°, the strata dipping towards the mountain.

This slate is compact, and is much broken and twisted, so that it would not answer for covering roofs. Occasionally a few good slabs may be obtained, which might answer for tombstones or for platforms, but no attempt has yet been made to quarry them.

Higher up the mountain we discovered a very singular breccia, made up of the large broken fragments of the argillaceous slate rocks, mixed confusedly with the granite which closely invests them. This breccia was evidently formed by the eruption of granite through a thick bed of argillaceous slate rocks, the strata having been broken into fragments of a rhomboidal form, and into pieces which vary from a few inches to a yard or more square.

The fragments lay in every imaginable position, just as if they were swept up by a thick, pasty mass of semi-fluid granite, which indurated around them by cooling. Some of the masses were rendered scoriacous, and resemble vesicular trap rock, but generally they do not appear to have been much altered by heat.

The granite contains no mica, but is composed principally of felspar, with a little quartz. There are no rounded or water worn pebbles in the breccia; hence it cannot be considered as a conglomerate of aqueous deposition.

This locality proves most incontestibly the correctness of a statement made in my reports on the geology of Maine, that the eruption of the granite rocks of this region took place immediately after the deposition of the roofing slate, while other localities in Maine indicate that the eruption was anterior to the deposition of the red sandstones of the St. Croix and New Brunswick.

On reaching the summit of Pequaquet mountain, the rocks were found to consist of a very hard breccia, composed of the same kind of granite before described, containing small fragments of slate, rarely more than an inch in diameter.

Drift furrows occur on the surface of the included masses of slate, at about half way up the mountain, and run N. 30° W., S. 30° E., and it is evident, from their uniform course, that they were produced since the slate was included in the breccia.

From the summit of this mountain the following bearings were taken, by means of a Messiat compass:

Mount Washington,	N. 30° 30′ W.
Baldface mountain iron mine,	N. 62° 30′ W.
Chocorua peak, highest,	S. 52° 30′ W.
Fryburg village,	S. 31° 35′ W.
Lovel's pond,	S. 37° E.
Chatoque corner,	S. 20° E.

Saco river is seen to the S. W., and winds around to the S. E., forming an ox-bow at Fryburg village.

The ranges of mountains seen from this peak have a N. and S. direction.

The view of the surrounding country is truly magnificent, and is more picturesque than that obtained from the summits of very elevated mountains.

We were not able to measure its altitude above the sea, on account of the accidental

breaking of the barometer a few days previous. It is, however, a lofty mountain, since the only vegetation on its summit consists of the high Alpine plants, such as grow near the summits of Mount Washington and La Fayette, but it is not so high as even the last mentioned mountain. (See a subsequent exploration and measurement of this mountain in another part of this report.)

From Bartlett to Eaton the rocks are uniformly granite, and the soil is composed of its finely comminuted particles.

In the town of Eaton, in 1826, I had occasion to examine a vein of sulphuret of lead and blende, which was discovered at that time, and was subsequently wrought to some extent by Messrs. Binney, Ripley and Tyson. At the time of my first visit, the country around the mine was a wilderness, and but a few blasts had been made to extract samples of the ore from the vein. Since that time a shaft has been sunk into the vein, to the depth of 40 feet, and a quantity of the galena was extracted for trial. Fifteen barrels of the picked lead ore, weighing from 1,200 to 1,260 lbs. each, were sent to Baltimore for reduction to lead, and several hogsheads of it were sent to Boston by the way of Portland. The zinc ore which forms the principal mass of the vein, was entirely neglected, and several hundred tons of it now lie near the mouth of the mine.

I thought it would prove interesting to make a renewed examination of this vein, in order to ascertain the practicability of working it for zinc, and re-visited it for that purpose.

The width of the vein, as I had before stated, is six feet, and it consists mostly of yellow blende, or sulphuret of zinc, which includes veins and scattered masses of galena or sulphuret of lead. The course of the principal vein is N. 21° E., S. 21° W., and it dips to the westward 60° or 65°. Beside this occur a number of smaller veins, from a few inches to one foot wide. Drainage is practicable and easy for the depth of more than 100 feet, into a pond close by it on the north. A gallery should be cut from this pond to the vein, so as to free the mine from water, the vein being readily struck at a lower level by this means, while by continuing the present perpendicular shaft, ventilation may be readily and conveniently effected. A vein six feet wide affords ample room for the miners to work, keeping always among the ore, so that no labor will be wasted. I have no doubt that this mine will prove valuable, provided the zinc ore is wrought. The lead ore may be separated into one heap, and the zinc into another, so that both ores may be wrought at the same works. The zinc ore contains 63 per cent. of metallic zinc, according to my analysis, and should yield in the large way from 35 to 40 per cent. of the metal. (See analysis and assay of this ore.)

The lead ore contains 84 per cent. of lead, and should yield 75 per cent. when smelted in the large way. (See assay.)

1000 pounds of the lead ore contains 1 pound of silver, and if the lead is converted into litharge, after the English and German methods, the silver may be separated and refined. If all these operations should be carried on at the same works, it would be necessary to have a large capital and experienced workmen to conduct the operations.

An abundance of charcoal may be obtained for supplying the furnaces, and its present price is $4 per hundred bushels.

It is hoped that persons interested in mines will attend to this valuable vein, for it is one of the largest and richest in New England.

Copper pyrites has been found two miles N. E. from Atkins' tavern, in Eaton, and bog iron ore near Walker's pond, in the east part of the town; also on Larey's hill. I saw specimens of the ore, but was unable to visit the locality, on account of illness, which confined me to the house for a week. (See subsequent explorations.)

Lead ore also exists near white pond, in Tamworth, but I was not able, at the time of my visit to examine the locality, but shall take an early opportunity to explore the veins and ascertain their value.

The rocks in Tamworth and Moultonborough are granite, cut through occasionally by powerful dykes of greenstone trap rock and sienite. Ossipee mountain and Red hill present interesting examples, and have been described by my assistants in a former section. The region around Winnipissiogee lake was also explored by them, and I subsequently visited it for the purpose of obtaining some additional information respecting a vein of iron ore on Gunstock mountain, in Gilford, and statistics concerning the fertility of the soil on Cow and Long islands.

In the chemical and agricultural departments, I shall state the facts learned on this subject.

The vein of magnetic iron ore on Gunstock mountain, was opened for the purpose of obtaining iron ore for the supply of a furnace, but was soon abandoned, since the vein was found to be too narrow to furnish an adequate supply of ore. The ground around the mine is covered with an abundance of the ore, which is highly magnetic with polarity, and will furnish an abundance of native magnets.

From the summit of this mountain we have a magnificent view of Winnipissiogee lake, with its numerous bays and islands; of the latter we counted no less than sixty in full view. The mountain is elevated 1583 feet above the ground at Gilford, and is 2068 feet above the sea level.

By a meridional observation of the sun, its latitude is N. 43° 31′ 56″.

The following bearings were taken with a Messiat compass from the summit of Gunstock mountain:

Meeting house at Meredith Bridge,	N. 78° 20′ W.
North peak, Ossipee mountain,	N. 16° 25′ E.
Chocorua peak,	N. 17° 30′ E.
Centre Harbor meeting house,	N. 9° 30′ W.
Meredith Village Cong. meeting house,	N. 26° W.
Wolfborough Village Bridge,	N. 72° 25′ E.

These observations may prove of some utility in fixing the situations of places on the map of the State.

Loose blocks or boulders of limestone occur in Gilford, but no such rock has yet been found there in place.

They have been found, it is said, on the estate of Dr. J. L. Perley, of the size of a bushel basket. The rocks on the farm belonging to Dr. Perley's father, three miles to the north of this place, are said to be sufficiently calcareous to effervesce with acids, but are not like the masses of limestone which have been found loose.

Near Meredith Bridge there is a small deposit of peat, which is from 2 to 3 feet deep, and may be converted into a valuable meadow by suitable treatment.

Specimens of plumbago were shown me, which were said to have been found in Thornton.

Centre Harbor and the other places of interest around this lake, have been described by my assistants.

Canterbury, the seat of a flourishing Shaker settlement, is founded upon granite rocks, and possesses a granite soil, which is not naturally fertile, but by the patient industry and skill of the society of Shakers, is rendered productive.

The rocks in the town are not interesting, and, so far as we were enabled to observe, do not promise to be important as localities of minerals. My attention was, therefore, called to the condition of agriculture with the Shakers, and I had the satisfaction of proving useful to them, by calling their attention to the value of a large tract of peat land which they possess, but had not then rendered valuable by improving it.

The bog is about half a mile from their dwellings, and comprises about 50 acres. It is more than thirty feet deep, and may be easily drained and cultivated. By cutting ditches around the margin of the bog, the lateral springs may be intercepted, and drawn off into a general drain. The peat dug from the ditches will furnish an abundance of vegetable matter for making compost manure, and when the bog is once drained, its surface may be turned with a plough, and then rolled down, manured and planted. In short, I should recommend precisely that method of treatment which is employed by Elias Phinney, Esq., of Lexington, Mass.; an account of which I have formerly published in my reports on the geology and agriculture of Maine and Rhode Island. (See report on this subject by Wm. Tripure.)

From Concord I explored the geology of the country to Hillsborough, and from thence to Amherst, from whence I measured a sectional line over the country to the westward, passing through Peterborough and over Monadnock mountain, in Dublin, to Keene, and from thence to the Connecticut river, at Brattleborough, Vt.

A brief outline of this section is all that can at present be attempted.

In Hillsborough occur a few minerals of interest, which will be mentioned more particularly hereafter.

Graphite or plumbago is found in a state of great purity, but the veins are narrow, rarely being more than 8 or 10 inches wide. It is included in mica slate, which is cut through by a vein of granite.

The locality is of value to those residing in the neighborhood, since mining for plumbago may occupy their leisure time, and will repay them well for their labor, since it is worth $60 per ton for the manufacture of crucibles, and is now in constant demand.

In Goshen a plumbago vein is wrought by Mr. Pierce of Hillsborough, who employs a number of men advantageously, part of the year, in the business, and supplies a large quantity of plumbago to the manufacturers of crucibles in Taunton, Mass. Mica slate, gneiss and granite comprise all the varieties of rocks on this route, until we reached Francestown, where a very valuable bed of soft talcose rock or soapstone occurs, imbedded in the mica slate.

Description of the Soapstone quarry at Francestown.

Soapstone of excellent quality exists in Francestown on the estate of Daniel Fuller, Esq. It was discovered by him accidentally in 1794, while engaged in ploughing his field. He remarked that the plough and harrow did not make any gritting noise in passing over this ledge, while it did on the others, and on examining the rock, found it to be a soft variety of soapstone. It was first wrought in 1802, and was transported to Boston, for sale, in 1812. Since that time the value of the stone has been steadily increasing, and is now in greater demand than ever.

I visited this quarry, examined the rock with care and obtained, through the politeness of Mr. Fuller, a full statistical account of the business. The quarry is situated one mile eastward of the Francestown meeting house.

The soapstone is a very soft variety of crystaline talcose rock, composed entirely of the interlaced crystals or laminæ of Talc. It is a regular bed included between walls of mica slate, and runs parallel with the course of the strata N. E. and S. W., and dips to the N. W. 60°. In its widest part the bed measures 40 feet in thickness, and it narrows to the southwestward to 20 feet. In the middle it measures from 25 to 30 feet. It has been quarried to the depth of 40 feet, but the natural drainage keeps the quarry free from water only to the depth of 36 feet. The length of the bed, so far as it is exposed to view, is 400 feet.

A small part of the southwestern extremity of this bed is owned by Mr. Daniel Clark, who also quarries the stone. It is not improbable that the soapstone will be found to extend beyond its present ascertained limits, and it will be worth while for those who are interested, to examine the country to the northeastward and southwestward of the openings, where the stone is now wrought.

The mode of quarrying soapstone, which is here employed, is to saw out the blocks by means of large crosscut saws, so as to obtain sound blocks and to waste as little as possible.

Mr. Fuller proposes to erect a small steam engine to pump out the water from the quarry, and the same engine will drive saws for manufacturing the stone into slabs. (See another section of this report for statistics of this business.)

From Francestown to Mount Vernon the rocks are mica slate and granite. In the latter town, just before descending into the valley of Amherst, there is an abrupt mass of a coarse variety of granite containing white felspar. A sudden descent conducts to the plain, where the pretty village of Amherst is spread out in a valley of ancient alluvial origin, which appears as if it once formed the basin of a lake but was subsequently filled, in part, with soil.

Only a short time was devoted to the examination of this town, since the rocks are generally concealed from view and but little real information could be obtained from inspection of them.

Leaving Amherst, after obtaining much useful agricultural information, through the politeness of Mr. Peabody, we continued our route to Peterborough, observing that the rocks in Milford, Wilton and Temple, consisted of gneiss and porphyritic granite. The

gneiss in Peterborough contains iron pyrites, and by its decomposition the rock is strongly stained with the peroxide of iron. Numerous blocks of porphyritic granite, out of place, rest on the surface of the soil.

We next visited Jaffrey, near the base of Monadnock mountain, and having made some astronomical observations to fix the latitude of the place, we ascended to the summit of Monadnock, carrying with us a sextant, artificial horizon, one of the barometers and a compass. Mr. Cutter of Jaffrey kindly volunteered to guide us by the easiest route to the summit of the mountain.

Setting out on foot from the house of Elias Mann we began the ascent, remarking that the rocks for the first part of the way are gneiss and mica slate, the strata of which dip to the northward. The mica slate contains an abundance of fibrolite, which gives it a porphyritic appearance. Higher up we noted the occurrence of drift scratches on the surface of the rock. They run N. 35° W., S. 35° E.

Above this we came to narrow beds of plumbago, which is not pure enough to prove valuable. Pyrope garnets also abound in the granite veins.

At 11, A. M., we reached the summit of the mountain, and after making due preparations, took the requisite observations for determining the height and place of the mountain.

The rocks on the summit of Monadnock consist of a hard variety of gneiss filled with small crystals of garnets. The plants are generally of an Alpine character, and only a few dwarfish spruce trees grow in the crevices of the rocks. The declivity of the mountain is celebrated for the abundance and fine quality of its blueberries, which tempt the people resident in the vicinity, to ascend the mountain for the purpose of gathering them.

The surrounding country seen from this elevated peak, appears to be an extended plain, the surface of which is studded with villages. Keene bears N. 30° W.; Jaffrey, S. E.; Fitzwilliam, S. 30° W., and Wachusett mountain, S. 15° E.

Descending, we continued our journey to Keene, where several days were spent in examining the various localities of minerals.

The granite and mica slate of this town contain large veins and beds of milk quartz, which is used at the New Hampshire glass works for the manufacture of cylinder window glass, which is of superior quality.

In the town of Swanzey, near Keene, Dr. Smith guided me to a locality where magnetic iron ore occurs in large crystaline masses, disseminated in a granite vein.

The ore occurs on a low hill and is contained in veins of granite, which traverse the gneiss rock in a direction N. 5° W., S. 5° E. The veins are 3 or 4 feet wide and extend for the distance of 20 rods.

The masses of iron ore are imperfectly octahedral and split into plates or folia. The locality furnishes interesting specimens, but it will not prove valuable as an iron mine, for it would cost too much to pick the ore preparatory to smelting it.

West hill, in Keene, is the locality where the milk quartz, at present used for making glass, is obtained. The quartz occurs in veins which run north and south and dip to the westward. They vary in width from 18 to 75 feet, and are favorably situated for quarrying, since the hill is elevated about 150 feet above the plain and the slope is gentle. Be-

yond the summit of the hill are many other beds and veins of quartz, which have not yet been wrought.

A few narrow beds of plumbago are found associated with the quartz rock and mica slate, and considerable quantities have been obtained for commercial use, but the work has lately been abandoned.

Last year 20 or 30 tons of black lead were obtained from this mine, but it is extremely difficult now to extract it from the rocks.

A bed of dark colored soapstone occurs near this place, and will prove useful for coarse work, but it is rather too hard to compete with that which is found in Francestown.

The bed is 21 feet wide, and runs N. 30° W., S. 30° E., and dips to the S. E. 70°. A quarry has been opened for the extent of 50 feet in length, and some tolerably good stone has been obtained.

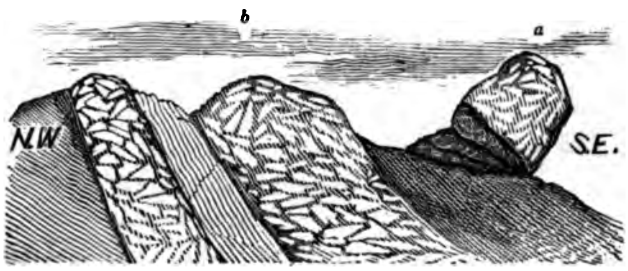
A very handsome light colored granite is extensively employed for building in Keene, and is quarried in the towns of Roxbury and Marlborough.

From Keene to Gilsum granite abounds, and forms beds and veins in the gneiss and mica slate. The latter rock occasionally passes, by imperceptible shades, into hornblende slate containing garnets. On the hill the strata dip to the S. S. E. Beyond this rock we come to a variety of mica slate stained strongly with the peroxide of iron.

Near the house of Mr. Samuel Bingham, in Gilsum, there is a huge block of coarse granite resting upon the crushed edges of strata of mica slate. This remarkable block of granite has received the name of the Vessel Rock, and it appears to have been stranded upon the mica slate ledge, where it was deposited by the drift current which passed over the country in ancient times.

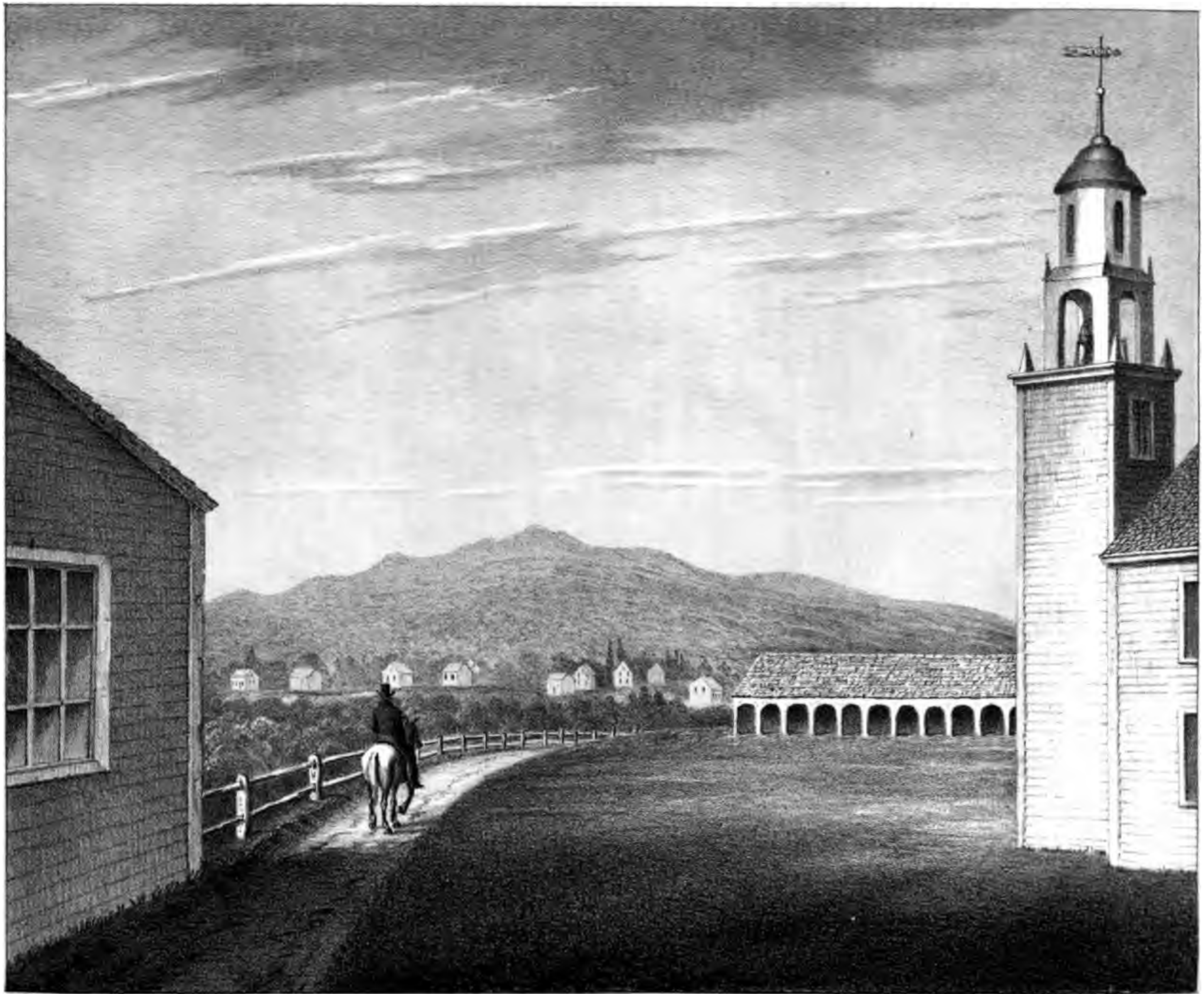
This block of granite was split asunder in the winter of 1817, when an immense mass of it was separated probably by the action of frost. Some of the people resident in the vicinity impute this fracture to the agency of an earthquake, which is said to have taken place at the time mentioned.

The principal block measures 46 feet in length, 24 feet in width, and it is 26 feet high. The portion which was split off in 1817, measures 33 feet in length and 10 feet in width. The principal block contains 28,704 cubic feet, and the lesser 3,300 cubic feet, the whole mass including 32,004 cubic feet of stone, which, allowing 14 cubic feet to the ton, will weigh 2,286 tons.



Vessel Rock, Gilsum.

a. The erratic block of granite.
b. The original bed from whence it was probably broken off.
The dark lines represent the strata of mica slate on which the erratic block rests.



C. T. Jackson del. C. Cook's Lith. Merch^ts Exc^e Boston.

MONADNOCK MT. FROM JAFFREY.

Some suppose this huge rock was transported from its parent ledge in Alstead; but since we found a large bed of similar rock 135 feet to the northwestward of it, there is more probability of its having been transported from that spot to its present situation by the impulse of water, aided by the uplifting power of ice. The removal of such an enormous mass of granite, even to this distance, is a matter of astonishment.

Surry mountain contains small beds of plumbago which have been wrought for the manufacture of melting pots for copper founders. The mine exists on the estate of Mr. Livermore, and is owned by some person resident in Boston. We were unable at the time of our visit to examine the locality in order to ascertain the extent of the plumbago.

Having before described the outlines of the geology of Chesterfield and of Westmoreland, it will only be necessary to refer to our longitudinal section, for the description of the remainder of this outline of a transverse section from the Merrimack to the Connecticut river.

Referring the Economical Geology of the first annual report to the end of this, I shall now give an account of the field operations of the second season of the survey—it being more convenient for the reader to have the whole of the economical geology collected together, so that it can be consulted more readily; and there will be, also, an advantage in bringing the observations of several years into a more compact form—many of the most important localities having been visited several times, where it was thought that new discoveries might be made, which would prove useful. The economical department of this report will then be a general *resume* of the description of mines, accompanied by the chemical researches which have been made on the various ores, that have been discovered during the progress of the work.

SECOND YEAR'S SURVEY.

EXPLORATION OF THE SOUTHERN RANGE OF TOWNS BORDERING ON THE STATE OF MASSACHUSETTS, AND THE EASTERN RANGE OF TOWNS BORDERING ON MAINE.

Making Nashua our head quarters at the commencement of the second season of our survey, a party of my assistants was sent to explore the southern range of towns between that place and the Connecticut river, while I pursued a route in the opposite direction, towards Portsmouth, passing through Hudson, Windham, Londonderry, Hampstead, Kingston, Exeter and Greenland, visiting, also, the towns a little to the south of this line, when the rocks could not be discovered on our section. From the geological survey of Massachusetts we had learned that but little of geological interest could be expected on this route, for the strata are continuations of those which occur on the Massachusetts side of the State line. More attention was, therefore, paid to the nature of the soils, and much time was spent in aiding the farmers in making the best use of the resources, which they could command in rendering the soil more fertile. A few towns were unfortunately omitted, which were not conveniently situated for exploration at that time. This ought not to be imputed to any intentional neglect on my part, but to want of time, the survey being limited and much remaining for us to do before an outline of the geology of the State could be prepared.

The southeastern boundary of the State is a very crooked and irregular line, along which no section could be made without running into Massachusetts, and a more northerly course was therefore selected in preference, as above indicated.

Examination of the town of Nashua.

This important manufacturing town is situated at the junction of the Nashua with the Merrimack river, and is traversed by the Concord and Boston railroad. It is based on a thin and rather barren soil, composed of sand that was drifted there in ancient times, and a finer sandy loam derived from the wash of the rivers. Clay is rarely found and is very sandy, insomuch that a good bed of clay would be highly valued, both for brick making and for the amelioration of the soil.

The rocks are mica slate and gneiss with gneissoid granite, which is quarried extensively for building stone.

Accompanied by Israel Hunt, jr. Esq., I visited and examined the quarries of this rock, which have been opened by that gentleman and by the Nashua company. They are situated near the falls, in the midst of a forest of pitch pines, which grow on the thin sandy soil that covers the rocks.

The Nashua company has uncovered several acres of the ledge, and fully exposed the rock to view. It is a compactly stratified granite gneiss, having but little mica, which lies in parallel planes so as to facilitate the splitting of the stone in the direction of their laminæ. It is light colored and makes a handsome building stone. The factories are constructed of it. At the quarries the strata trend in a N. E. and S. W. direction, as indicated by the line of direction of the mica, and by the sheets of stone which are naturally divided parallel to the plates of that mineral. The rock dips to the southeastward. Sheets of this stone about 2 feet in thickness, and of any required length and breadth, are easily obtained. The quarry is of great value to this rapidly growing town, since the stone may be so cheaply obtained as to supersede the use of wood in the construction of dwelling houses and stores. The price of stone in the quarry, as I was informed, is from one shilling to twenty-five cents the perch, and rough split it sells for seventy-five cents a perch.

Mines falls is one of the localities which I was requested to examine, ancient tradition having given that place credit for valuable metaliferous ores. Mr. Tyler, of the Indian Head hotel, gave me a few fragments of galena which he had obtained there, and Mr. J. Eayres volunteered to guide me to the locality. The rocks at the falls are indurated mica slate, dipping to the S. E., and cut through in several places by granite veins, and including beds of gneiss and quartz; a few very narrow strings of galena or lead ore occur in the bed of the stream below the falls, but no good specimens could be obtained without blasting. The largest pieces which were given to me were but one inch in diameter. On reducing a portion of this galena to lead and then cupelling it, a small globule of silver was obtained. The veins are too narrow to furnish any valuable quantity of ore, although it is rich enough to work, if it could be obtained in abundance.

I am indebted to Mr. Fox of Nashua for the following extract concerning this celebrated locality:

"The islands at the falls of the Nashua river, in Nashua, about two miles westerly of the village, acquired the name of '*Mine islands*' at a very early date. As early as August 28, 1682, they were granted to Hezekiah Usher by that title. Lead had probably been discovered there and wrought by the Indians, and after the islands came into the possession of Usher, the tradition is that considerable explorations were made by him. It is known that the banks of the Nashua, the Souhegan and the Merrimack were carefully explored for mines, and that Mr. Baden, an ingenious miner and assayer, was sent over to New England for this purpose. Lead ore was found, but not plenty, and so intermixed with rock and spar as to be not worth working. (2 Douglass' Summary, 108. 5 N. H. Hist. Collections, 88.)

Usher was one of the original proprietors of the township, a man of wealth and enterprise, and uncle to John Usher, Lieutenant Governor of New Hampshire in 1692. He seems to have been a speculator, and to have imbibed the extravagant ideas, then preva-

lent among that class of emigrants, respecting the great mineral wealth of New England. They had read of Mexico and Peru, and had listened to the Indian as he told of the 'great carbuncle,' that dazzled the eyes of the beholder, upon the summit of the White or 'Crystal Hills,' the throne of the Great Spirit, which no human foot had trodden or dared to tread. Visions of gold and silver lying hidden in the bowels of the earth in untold quantities, floated before their distempered fancies by night and by day. Every sparkling rock, every discolored spot of earth was to them an El Dorado, and such, without doubt, were the '*Mine Islands*' in the eyes of Usher.

Excavations were made there, and lead and iron, it is said, were found in small quantities, but the enterprise proved a fruitless one and was soon abandoned. This was probably not very long after they were granted to him, as in 1685 he was hunting for mines in Deerfield, Mass., and in May, 1686, Mason, the proprietary of New Hampshire, 'farmed out to him and his heirs, all *the mines, minerals and ores* within the limits of New Hampshire, for the term of *one thousand years*, reserving to himself *one fourth* of the *royal ores*, (gold and silver,) and *one seventeenth* of all the *baser metals*.' (I. Belknap's History of New Hampshire, 116. Mass. Colony Records, 1685.) Of such a character and extent, however, were the explorations at these islands, that they were familiarly called '*the Mines*' in all letters, records and journals of scouting parties, for half a century afterwards."

Leaving Nashua for Exeter and Portsmouth, we noticed on our way the following rocks. Four miles from Nashua, near Hudson village, mica slate rocks appear in ledges, the strata of which dip to the N. W. 65°. A mile further to the eastward the strata dip in the opposite direction, or to the S. E. A little further eastward the dip is again to the N. W. These changes in the inclination of the strata indicate a crowding or folding of the mica slate, and the line of folding will be observed to extend for a considerable distance along the course of the strata, as represented on the accompanying geological map.

It was remarked that the soil changed in character when it rested on mica slate rocks of this district, and is of a much darker color than the fine drift of the Merrimack. It is much more loamy and retentive, and is evidently a good and fertile soil, bearing luxuriant crops of Indian corn and the usual agricultural produce of New England.

In Windham and Londonderry mica slate rocks form the solid substrata, including in the latter town some beds of granite and veins of quartz. In Hampstead we came to granite and hornblende rock, the latter containing included fragments of granite, showing its eruption to have been subsequent to the elevation of that rock. Boulders of porphyritic granite occur in abundance on this section, and since no rock of the kind occurs in place in this region, are referred to the drift from the northwest, since it abounds in that direction, forming mountain masses. In Exeter the rocks are mostly covered with fine drifted soil which is regarded as fertile. The rocks which here and there crop out, are mostly granite. The rocks of Kingston, Kensington and Hampton are also covered with a good soil, composed of the fine drifted particles of mica slate and granite rocks.

At Hampton Falls the hard flinty slate again appears and extends to the sea coast, where it is cut through by dykes of trap rocks.

Rye and Portsmouth have already been described, and it will be unnecessary to repeat the details respecting the rocks which occur there.

In Kittery, Me., Mr. Hayes discovered a deposit of tertiary formation like that discovered by me in the vicinity of Lubec, Maine, and at the same height above the sea level. This deposit was first noticed in digging a well in a little valley where clay marl, mixed with an abundance of marine shells, was found. The shells are the following: Saxicava rugosa, Mytilus edulis, Sanguinolaria, and Astarte castanea. The valleys, which are not more than 30 feet above high water mark, are generally filled with this clay marl, mingled with the above mentioned shells. Similar deposits have since been noticed in the neighbourhood of Portsmouth. Submerged forest trees have been observed near the shore.

In South Berwick, Me., there is also a more elevated tertiary deposit, which contains an abundance of fossils of marine origin, and a variety of curious concretions. A few years since a well was sunk on the estate of Mr. Charles N. Cogswell, and at the depth of 30 feet from the surface, marine mud, containing a mass of black animal mould and petrified bones of a seal, were discovered. The men who dug the well apprehended that they were bones of a human being and refused to work there any longer. The bones being sent to me, were compared with those figured by Cuvier, and were decided by Dr. Wyman to be the humerus radius and ulna of the seal.

Remains of this class of animals are rare in our tertiary deposits.

The order of strata in this deposit was learned from Mr. Cogswell to be as follows: drift soil, from 2 to 4 feet; clay, 30 feet; flats mud and gravel at the bottom in which the seal's bones were found.

A similar deposit was dug through on the estate of Mr. Jedediah Jenkins, and 30 feet from the surface, flats mud and "clam shells" were thrown out by the well diggers.

The same strata were dug through on the estate of Mr. Nason.

The tertiary valleys of South Berwick were cut through in a northwest and southeast direction by the waters of the drift epoch, and the river flows amid the hills which originally formed the bed of the sea. On comparing the marine shells of this place with those collected at Westbrook, Me., it was evident that the two deposits belong to the same epoch, both containing the Nucula Portlandica. This deposit is probably the Pliocene of Lyell, while that at Kittery is the Post Pliocene, or more recent.

Although without the limits of the State of New Hampshire, the tertiary deposits of these places are interesting, since they are immediately on the borders and indicate the former submergence of the district where they occur.

My principal object in visiting South Berwick was to examine the farm of Judge Hayes, whose admirable improvements are worthy of imitation by the farmers of New Hampshire. (See the agricultural department of this report.)

Leaving South Berwick we went to Salmon Falls, where the hard blue metamorphic cambrian slate rocks occur and evince the action of igneous rocks. The strata are almost vertical, inclining to the S. E. 80°.

At Great Falls the same kind of rocks occur and dip to the S. E. 40°.

In Rochester our attention was directed to an extensive peat bog, comprising more than 150 acres, and not less than 40 feet in depth. It is but half a mile from the flourishing village of Rochester, and will prove of great value both for fuel and for agricultural use. The bog may be easily reclaimed by draining off the surplus water into the Cocheco river

by means of ditches which need not be more than six feet in depth. Several citizens of Rochester who visited this bog with me, resolved to purchase, reclaim it, and convert it into a meadow for English grasses. They were advised to visit the farm of Judge Hayes of South Berwick and of Elias Phinney, Esq., of Lexington, Massachusetts, where they might learn two different methods of effecting these agricultural improvements, both of which are good, but Mr. Phinney's appears to be the best adapted to the cultivation of this deep bog. I have no doubt of its proving more valuable than any upland soil in the town. (See the agricultural part of this report.)

Rochester is probably underlaid by strata of mica slate, which is covered by drift consisting of fine sand and sandy loam.

Passing through Milton to Ossipee, we leave the sandy plains, and find ledges of mica slate rocks which dip to the N. W., and are succeeded by gneiss, which continues to Ossipee lake.

Revisiting the town of Eaton, it was thought best to examine the mines of zinc and lead ore again, for the purpose of marking on the ground the direction of the vein, and to measure the depth of practicable drainage for the mine. Aided by two hired men, we uncovered a portion of the vein, and measured its direction by means of the Messiat compass, marking its coarse on the trees next to the pond, and driving a stake in the other part of its course. The vein was found to run in the direction N. 27° 30′ E., S. 27° 30′ W. The dip is to the W. N. W. 51°.

The distance from the mine to the pond is 623 feet; height above the pond 107 feet—which determines the depth of natural drainage of the mine by a gallery to be cut for that purpose. From its course it appears that the vein runs across the northwest side of the pond, and the explorations which had been made towards the pond, were to the eastward of the vein. These observations may prove useful to those, who may hereafter open the mine for the purpose of extracting the zinc and lead ores.

The bearing of Joshua Nickerson's mine was taken from this place, since it was supposed to be a continuation of this vein, but since it was found to bear N. 58° E., this cannot be the case.

Several localities which were not examined last year, were visited and explored by us during this visit to Eaton.

Mr. Joshua Nickerson's lead mine was examined, and it was found that a shaft 25 feet in depth had been sunk in the rocks in pursuit of a narrow vein of galena and blende, which was not found of sufficient magnitude to warrant the expense of mining. The vein at the surface is but one inch wide, and the widest expansions or nests of galena were but three inches wide. Masses of blende were also found of similar dimensions. The veins run N. 31° E., S. 31° W., and dip to the W. N. W.

Mr. Thomas Randall exhibited to me on a former occasion some specimens of iron and copper pyrites, which were found on his estate two miles northeast from Atkinson's tavern. On visiting this locality, we found veins or dykes of a singular porphyry, having a greenish compact felspar base, and in these dykes occur the ore veins. The porphyry dykes cut through a hill of granite composed of a pure white felspar, quartz and bright transparent mica. Porphyritic granite, also, abounds in the vicinity, forming extensive ledges. These

dykes of greenstone trap from 10 to 16 1-2 feet wide, traverse this rock, and run in a N. 70° E., S. 70° W. direction. One of the dykes contains carbonate of lime in sufficient quantity to produce rapid effervescence with acids. It contains, also, crystals of hornblende, epidote and felspar. The surfaces of the dykes of trap were furrowed deeply in their linear direction, following the slope of the hill by recent causes, viz., by the running of water mixed with gravel, and by the gliding of masses of ice on the surface of the rocks. Although they resemble drift or diluvial scratches, they cannot be regarded as belonging to the same epoch, for they do not coincide in direction with those seen on the neighboring ledges, which were not affected by the running waters from the hill. The ancient drift scratches in this vicinity run from N. 5° E. to S. 5° W., and N. 10° E., S. 10° W.

Near the mine crystals of smoky and limpid quartz have been found, some of which have been sold for a high price.

The mine is a perpendicular shaft about 7 feet in depth, and was sunk for the purpose of obtaining iron and copper pyrites, but the vein is too narrow and the copper ore too rare for profitable mining.

One of the veins contained white pyrites, which by decomposition is so disintegrated that it is easily dug out with a pick and shovel.

Six mile pond in Eaton was visited by my assistants in company with Mr. Artemas Harmon, and a quantity of excellent bog iron ore was discovered at the northeast end of the pond. I visited the locality with them, and examined so far as we were able, the extent of the deposit. Having no boat, we were obliged to swim over the surface of the bed and dive to the bottom to obtain specimens, and by means of a pole we were enabled to loosen the ore from the bottom, and discover in some places the thickness of the deposit. Its extent, so far as ascertained, is 150 yards by 50 yards, and it is at least one foot in thickness. The ore is of the best kind, being the apocrenate of the peroxide of iron, quite free from sulphur, arsenic, phosphorus or other deleterious substances. It will yield 40 per cent. of iron in the blast furnace, and will prove valuable for admixture with the heavy magnetic iron ores of Bartlett and Jackson. The known quantity of ore is about 2167 cubic yards, and it is probable that more will be discovered, since we were credibly informed that it had been seen beneath the water at the other end of the pond. A large quantity of the ore may be obtained by means of dredges, and it can be drawn to the shore by means of tackle attached to the trees; a team of oxen being used for the purpose. Bog iron ore was formerly obtained in considerable abundance from Ossipee pond, and it is said to be still quite abundant. (See remarks on smelting iron ores.)

Having heard of a lead mine in Tamworth, on the northeast side of White pond, on the estate of Mr. Moses Downs, we visited the locality in company with Mr. Hall of Tamworth, and the owner of the estate.

The mine proved to be a drift 20 feet in length and 5 feet in width, which had been excavated in a solid vein of recticulated and compact jaspery quartz rock, in search of lead ore, which occurs in small nests and groups of crystals disseminated in the rock and mixed with iron pyrites. No regular vein of lead ore was found at this place, and the largest bunches of galena were not more than two or three inches in diameter. Specimens of this

ore had been sent to Dr. Chilton of New York, and to Mr. Lauriet of Boston, for analysis and assay. The locality will not yield a sufficiency of ore to warrant mining.

While I was engaged in examining this mine, I sent my assistants, Messrs. Williams and Channing, to examine Chocorua mountain and to measure its height. They reported that they found the mountain very difficult to ascend. It was at first steep and obstructed by undergrowth of wood, as far as Bald mountain; then descending a little they passed a valley where the trees had been prostrated by a hurricane, over which they had to travel at no small risk. Ascending to the peak of Chocorua they traversed two other prostrate forests, and then reached the summit of the mountain by a very steep ascent. It was stated to them that they would find a pond on the top of the mountain, (a very common and erroneous notion,) but no water was found there, excepting low down the mountain's side. A few blueberries and mountain cranberries (vaccinium oxycoccus) grow on the small patches of soil on the top of this mountain, but there are no forest trees, and the rock is fully exposed. The entire mountain consists of coarse granite. The barometer was broken before they had reached Bald mountain, and therefore no measurement was made at that time, but by means of a level I subsequently determined its height to be equal to that of Pequaquet mountain, or 3358 feet above the sea level.

View of Chocorua mountain from Chatoque corner, Conway.

Chocorua mountain is situated in the township of Albany, formerly called Burton. It is one of the most conspicuous of the lower mountains of the White mountain group, and is seen to the best advantage from the road passing from Conway to Eaton. It is said to have derived its name from an Indian chief who lost his life on its summit.

The story related to us, was that one of Chocorua's children visiting the house of a white man residing in the vicinity, was accidentally poisoned by eating a piece of bread, which had been covered with arsenic for the purpose of exterminating rats or mice, and that the Indian would not believe that his child's life had not been taken wilfully. He, therefore, meditated revenge, and taking advantage of the absence of the white man, killed all the members of his family and burnt the house.

The white man on his return, discovering what had been done by Chocorua, collected his friends and pursued the Indian, who was surprised on the top of this mountain, near the edge of an abrupt precipice, which prevented his escape. The white man commanded him to throw himself off from this height, but Chocorrua declined, saying that he could not take away the life which the Great Spirit had given him, and turned to receive the fire of their muskets. He was shot, and on falling, is said to have cursed the soil. Hence, it is said the curse still remains upon the land, and the cattle of Burton sickened and died ever after.

This story may, perhaps, account for the notion commonly prevalent in this vicinity, respecting the diseases cattle are said to be subject to in Burton. We believe the trouble has been less since the town has changed its name, for certainly much less is said about it. The people, however, continue to give their cattle peat mud mixed with the hay, under the impression that it is salutary in preventing the disease to which they are said to be liable.

It is supposed by many that some poisonous minerals in the mountain contaminate the water and produce diseases, but there seems to be no foundation for such an opinion. The mountain is granite, and the soil is formed of granite detritus, and the water is as pure as any in the vicinity.

On visiting Conway, we were requested to examine a supposed iron mine at Robinson's corner, in the eastern part of Eaton. On proceeding thither, we found that the supposed iron ore was a dyke of greenstone trap rock four feet in width. It intersects a hill of granite and divides into three separate dykes in the upper part of the ravine. Its course is N. 55° W., S. 55° E. During the late speculation mania this rock was offered for sale as an iron ore, and a blacksmith was said to have made from it excellent bar iron, suitable for horseshoe nails! This of course must have been a mistake, for no iron can be obtained from this rock by the operations in a forge. It is not an iron ore.

Revisiting the town of Jackson, additional researches were made on Eastman's hill, where I discovered tin ore last year, and a quantity was blasted out from the north and south vein for cabinet specimens. Copper pyrites, purple copper and a little native copper were found at the junction of the trap dyke with the mica slate, where the dyke cuts off the tin vein. Phosphate of iron, arseniate of iron and tungstate of manganese and iron with fluor spar and mispickel were also discovered. The tin ore was found to be less abundant next to the dyke and copper pyrites took its place.

The tin ores obtained were analyzed and assayed in my laboratory during the winter, and their composition and yield will be stated in the chemical department of this report. Having given directions respecting the method of searching for other veins of this rare ore, we deferred farther exploration until the next season, and continued our researches northward, through the Pinkham woods, by a rough, rocky and muddy road made along the eastern flank of the White Mountains, ascending the hills whenever any thing appeared to attract attention to the rocks and minerals. On the road to Randolph, through the woods, numerous boulders and blocks of blue micaceous argillite, containing macles, were observed, and on reaching a deep ravine where a slide or land fall had exposed the rocks to view, these blocks were so abundant that I felt no doubt that the parent ledge from

which they were derived, would be found. On ascending this mountain the ledge of metamorphic slate containing this mineral, was discovered.

The rocks at the base of the mountain consist of large loose rounded and oval shaped blocks of macle slate, granite, trap rock and quartz.

Ascending the ravine we came to a granite vein cutting through the mica slate, which contains an abundance of iron pyrites. Above this were seen contorted strata of mica slate, cut through by felspar veins, and containing black tourmalines and a few beryls.

Above this is a blue metamorphic slate, containing mica of a brilliant silvery white color, and myriads of crystals of andalusite macle. The strata of all these rocks dip to the westward or towards the mountains, the uppermost strata having the least dip.

Through the whole mass of the ledge two large dykes of trap rock of a bluish black color, run and pursue a N. E. and S. W. course.

A little carbonate of lime, mixed with compact felspar, was noticed, and was found to effervesce freely with acids, but is too poor for burning for lime.

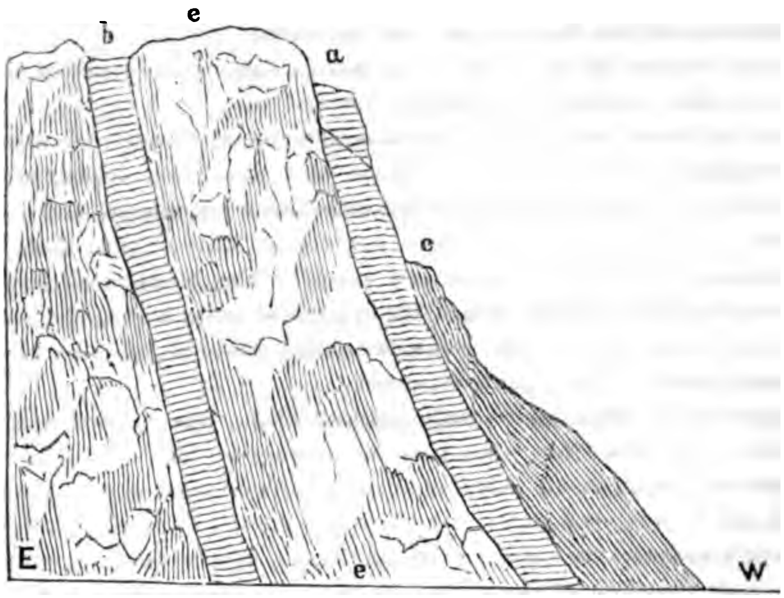
All the stratified rocks along this route dip to the westward, or a little to the north of west. The soil is good but rocky. A luxuriant growth of mixed hard and soft wood trees sufficiently indicates its fertility. Sugar maples, yellow birch, mountain ash, spruce and pine trees are abundant. The mountains to the eastward of the road are more thickly clad with dark forests of spruce and pine. It has been thought that a railroad might be made along this road, which is certainly not impracticable, so far as the grades are concerned, for there are no steep hills in the way. The principal difficulty would be in keeping the road open in winter and early in the spring, since there must be much snow on the steep mountain sides adjacent to the road, and there would be danger of an avalanche. It is said that in winter this road is very good for sleds, the teamsters from Lancaster often taking this route to Portland.

The highest land where the waters turn on the Pinkham road, is about 2,000 above the sea level, but the ascent is very gradual, and a good road will ultimately be made of it for summer traveling.

Stopping a short time in Randolph, a few observations were taken with the barometer, and then we rode to Jefferson and Lancaster. The rocks on the northern side of the White Mountains, along this road, are mica slate. No valuable minerals were observed. The country appears to possess a good soil and the roads are very good. Wheat is said to do well on this soil. Some days were spent in Lancaster and the adjacent towns in searching for limestone, and in examining the curious metamorphic rocks which abound in that place.

A singular limestone is found on the estate of Mr. Wilson of Lancaster. It is a compact bluish grey and white rock, evidently of metamorphic origin, containing a sufficiency of lime to cause rapid effervescence with acids, but when exposed to a sufficient heat to expel the carbonic acid from the lime, it melts into a black or dark green glass. It is more fusible than hydraulic limestone, and appears to consist in part of minute particles of hornblende. The most calcareous pieces will make hydraulic cement.

In the north part of Lancaster, on Town's hill, limestone is found in the fine grained hornblende rock, traversed by trap dykes, as represented in the following diagram:



a and *b* trap dykes, *c* limestone, *e* hornblende rock.

Near the junction of the trap dyke with the limestone, there is a thick layer of highly granular and pure carbonate of lime, while the principal mass of the rock is composed of a mixture of silicate and carbonate of lime, from which the latter may be removed by acids, leaving a porous white skeleton of the silicate. It was expected that in the valley, at the immediate base of this ledge, good limestone would be found, and by aid of several enterprising citizens of Lancaster, an active search was made, which resulted in the discovery of many loose square blocks of white limestone, containing 50 per cent. of carbonate of lime, the remainder being the silicate of lime. The solid ledge was not reached since the water not being drained off, obstructed the operation of excavating to the solid ledge, where a bed of limestone is supposed to exist. The valley below the cliff, where we observed it, appears to have been cut down more deeply than it probably would have been, if the hard rock extended across it to the westward. It may be worth the trouble to make more extensive researches at this place, for the limestone as represented in the diagram above, shows only its eastern border, and it is not improbable that it will be found somewhere in this valley. It is an interesting chemical and geological fact, that most of the limestone in these metamorphic rocks is converted into a silicate of lime, this being the effect known to result from heating a mixture of finely divided silex with carbonate of lime, the carbonic acid being expelled and the silex taking its place. It is, therefore, to be inferred that these ledges were, subsequent to the deposition of the particles of siliceous and calcareous matters, heated to full redness, since that degree of heat would be requisite to effect this thorough decomposition. An excess of carbonate of lime remained after saturation of the silicic acid, and is mingled with the rock throughout its mass.

Some immense blocks of granite occur in Northumberland, in the woods on the estate of Mr. Mills Olcott of Hanover, and we were invited to visit them in company with sev-

eral gentlemen from Lancaster. One of these rocks is of the following dimensions; 30 feet long, 18 feet high and 27 feet wide, and contains 4,580 cubic feet of stone. The other is 32 feet long, 6 feet high and 6 feet wide, and contains 1,152 cubic feet. It is a light colored granite of excellent quality for building. The house of Mr. Wells, of Lancaster, was built of a similar rock, and is a very handsome building.

These blocks of granite are different from any rocks found in place in the immediate vicinity, and incredible as it may seem, must have been transported thither by ice floes in ancient times. The nearest granite ledge is one mile north of it, but is of a different kind, and it was found impossible to identify any rocks, we could find, with these erratic blocks. Their original bed must be some distance to the northward.

Several peat bogs were examined in this town and vicinity. One on the estate of Mr. Solomon Hemmingway, comprises about two acres, and is valuable for agricultural use. Clay suitable for bricks also occurs there. On the farm of Mr. William Holkins there is a peat bog comprising more than 50 acres, and averaging 2 feet in depth. This bog may be reclaimed in the manner pursued by Judge Hayes of South Berwick, Me. (See agricultural remarks.)

The soil of Lancaster contains a considerable proportion of the salts of lime, and is peculiarly adapted to wheat and the other small cereal grains, which are produced in abundance.

In company with Dr. Dexter of Lancaster, I visited the town of Whitefield, where search was made for limestone, without discovering any that was good enough to burn for lime. Some interesting agricultural facts were collected, and a peat swamp was examined on the estate of Mr. Aaron Garnsey. It consists of 25 acres of good peat, which will make excellent compost, or may be reclaimed as a meadow by drainage. It is about 20 feet deep. (See agricultural observations.)

From this town a fine view of Mount La Fayette of Franconia was obtained, as represented in the following wood cut engraving:—

View of Mount La Fayette from Whitefield, bearing S. S. W.

Returning to Lancaster, some barometrical and astronomical observations were taken, to determine the height of that place above the sea level, and to fix its latitude. The height of the town above the sea, is 890 feet; its latitude, N. 44° 29′ 2″ 3; the observation being taken at Cady's hotel.

A few observations on the bearings of mountains were taken from the centre of the grave yard in Lancaster.

The highest peak of Mount Washington bears	S. 29° 15′ E.
Mount Adams,	S. 37° 25′ E.
Mount Prospect, in Lancaster,	S. 12° W.
Mount Pleasant,	S. 30° 30′ W.
Stratford peaks,	N. 41° 10′ E., and N. 42° E.
A mountain peak in Colebrook,	N. 28° 15′ E.
Bowback mountain, Stratford,	N. 6° 45′ E.

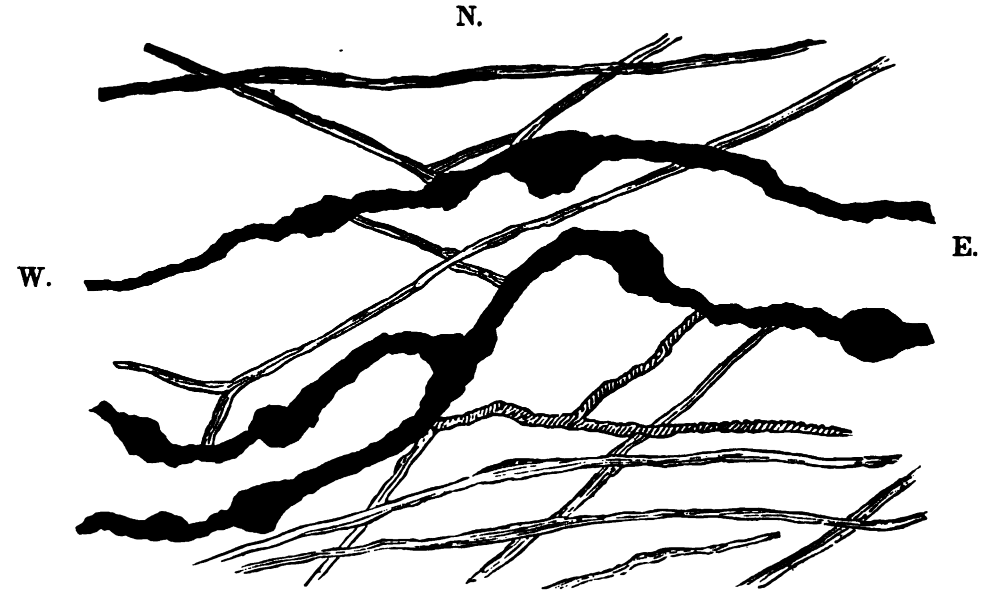
Leaving Lancaster, we traveled to Shelburne, passing through Kilkenney and Randolph. At Shelburne we were aided by Mr. Ingalls and several other gentlemen, who called our attention to the lead mine which had been partially explored six or seven years since. This mine is situated in the northwest part of the town, on the hill side, and in the bed of a small mountain rivulet. The ravine is a deep gap in the mica slate rocks which form the principal mass of the mountain, and in this are numerous veins of quartz and brown spar, with veins of lead, zinc and copper ores. Four or five men had been employed in blasting out the ore, so that we had a very good opportunity of learning the nature of the veins which had been wrought. We examined the ore that had been extracted from the rocks, and blasted open some of the veins to ascertain their thickness. The ores were found to be argentiferous galena, both granular and crystalized, black blende, crystalized in tetrahedrons and octahedrons, and also in foliated and compact masses, resembling black tourmaline in color and lustre, copper pyrites, purple copper ore, and iron pyrites. Quartz crystals also abound in geodes or cavities in the veins. The blende or zinc ore contains a considerable proportion of the black sulphuret of copper, to which it owes its remarkably dark color, and also contains a notable quantity of sulphuret of cadmium, yielding by analysis about 3 per cent., which is a larger proportion than usual. The first appearances of lead ore at this place were not very promising, but on opening the veins, they were found to widen very rapidly, being at first not thicker than the back of a case knife, but widening at the depth of 4 or 5 feet to 2 inches, with bunches of ore 6 or 7 inches in diameter.

The mine was opened under the direction of a Mr. Bates, formerly of New York, but now dead. About twenty-four hundred weight of the lead ore was transported to Portland, and from thence to New York, and a specimen of it was assayed for lead by Dr. James R. Chilton of that city. In the camp near the mine we found five boxes 2 feet long, 1 foot wide and deep, and filled with the ore. These we examined while the men were drilling the holes for blasting the ore from the ledge.

The veins present some interesting phenomena, the veins of quartz being cut off by those containing the metals. They have generally an east and west direction, and dip to the north 60°. The veins of ore contain much brown spar or carbonate of lime and iron

in the form of rhomboids and in foliated masses. The black blende fills the narrow parts of the veins, and the swells or pockets are filled with very pure and heavy masses of the argentiferous galena, almost free from the zinc ore.

The following diagram was drawn on the spot, and represents the appearance of the different veins; those in black being metaliferous. Iron pyrites occurs in brilliant crystals. The copper ores are found with the black blende.



Veins of argentiferous galena and black blende, Shelburne.

There is some difficulty in working this mine, for the water during the freshets in the spring season forms quite a torrent, and would prevent mining operations. By some labor and expense the brook may be turned off on one side, and for part of the year could be used for turning the wheels for pumping the mine, and as a power for pulverizing and washing the ore. There seems to be no way of turning off the stream higher up the ravine. If it is thought worth while to work the mine, a shaft may be sunk on the side out of the bed of the stream, and a level may then be carried in upon the veins. The ores are very rich but narrow. They may be wrought for lead, silver and zinc.

This mine is owned by Messrs. Mark Pierce, Barker Burbank, Robert Ingalls and Benjamin Leads.

A stock of 68 shares at $150 per share was created, and the attempt above alluded to, was made to work the mine, but was soon abandoned. It may be wrought at some future time, but will require the attention of a good mining engineer, and a sufficient outlay of capital to render the mine workable. Less promising localities are wrought in Europe. (See analysis and assay of the Shelburne ores.)

On the estate of Mr. Burbank, we found some black oxide of manganese and bog iron ore, but not in sufficient quantities to prove of economical value.

A peculiar tough kind of granite is found in this town, and is used for millstones.

The soil of Shelbure is remarkably rich and fertile, and there are some of the best farms in the State in this northern region. Wheat, oats and corn all grow well and yield unusually good crops. On the Androscoggin river, where it flows through this town, there are some very extensive intervals, covered with good crops of grass and ladened with wheat. Mr. Burbank's farm is the most extensive and best in the town. Some remarks on his farming operations and analysis of his soils will be presented in the economical department of this report.

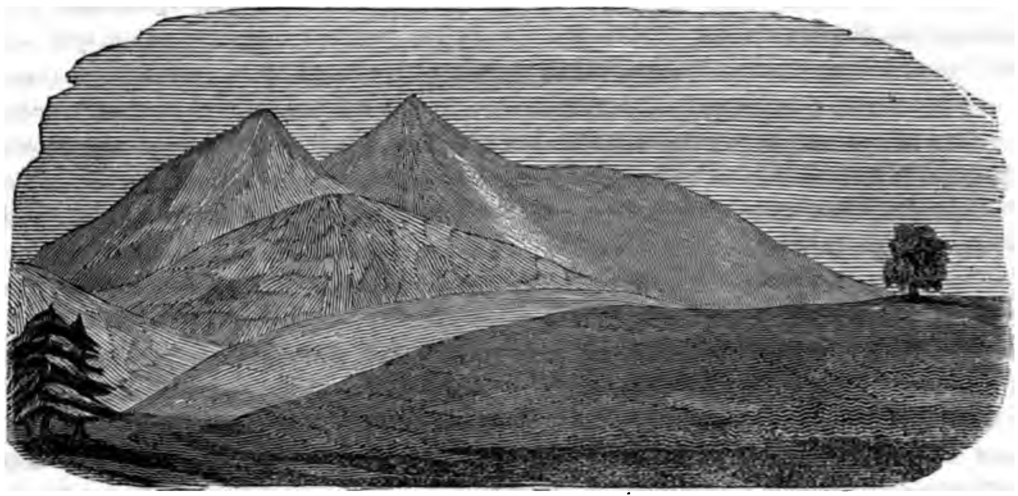
The latitude of Shelburne, by meridional observation of the sun, was found to be N. 44° 23′ 59″; height above the sea level, by barometrical observations, 821 feet.

On Mr. Burbank's farm, where the Androscoggin river cuts through the interval, we saw large numbers of forest trees buried in the alluvial soil at the depth of from ten to twelve feet. The trees project from the bank into the river, and are generally found to lie in a nearly horizontal position, the tops pointing to the northward. The wood is but little altered, and is sufficiently sound to be sawed, many of the maples having been dug out and manufactured into wheels for wagons. From the magnitude of the stumps of trees that were found on the surface, which were estimated to be at least 200 years old, and from the fineness of the strata of alluvial matter covering the buried trees, it is evident that they must have been buried there for a great length of time. The prevalence of clay over and around them, accounts for their not having undergone decomposition; the exclusion of air and the prevention of the circulation of water having contributed to their preservation.

Leaving Shelburne, we went to Berlin, and examined some localities of iron ore, which occur near the falls. The ore is octahedral magnetic iron ore, and is found imperfectly crystalized, and in large foliated masses of several hundred weight. It is, also, so abundantly mixed with the granite veins as to form a metaliferous porphyry. It would be a laborious operation to pick the ore clean and supply a furnace with an adequate quantity for the manufacture of iron. Enough may be obtained to supply a forge, and it may be readily converted into bar iron. Owing to the distance from large settlements, and the expense of bringing iron from a distance, it may prove useful in supplying the small quantity used by the people resident in the vicinity, but it cannot be manufactured in sufficient amount, nor cheap enough, to carry to a distant market. The granite veins, filled with iron ore, run in a N. E. and S. W. direction, and cut very obliquely through the mica slate and hornblende slate rocks, which run N. N. E. and S. S. W., and dip E. S. E. 40°

Trap dykes, both the porphyritic and dark brown compact variety, occur at Berlin falls. The porphyritic variety runs N. 80° W., S. 80° E., while the dark brown trap has a N. E. and S. W. direction. This variety is horizontally columnar. Crystals of hornblende and a little epidote are found in the hornblende slate rocks near the falls.

In Berlin, near Mr. Green's house, a fine view of the White Mountains, Mount Washington and Mount Jefferson, is obtained. The following sketch represents their appearance:



View of Mount Jefferson and Mount Washington from Berlin, bearing S W. by S.

From Berlin we traveled through Milan, Stark and Northumberland to Lancaster, examining the rocks near the line of our route. They consist of mica slate and quartz rock, with dykes of trap intersecting the strata in a N. W. and S. E. direction. The mica slate passes into talcose slate in numerous places, but no limestone was seen. Reticulated veins of hornblende rock occur in Northumberland, near the village. Leaving Lancaster again, we went to Stratford, Columbia and Colebrook. In Stratford the rocks are mica slate, and, at first, dip to the N. W., but a mile north of Beech's tavern the dip is reversed, or is to the S. E.

Approaching Columbia, the rocks are blue mica slate passing into argillaceous slate, and contain some valuable beds of limestone.

The most remarkable locality in Columbia is the lime or marl pond, which is two miles southeast from Chamberlain's tavern, in Colebrook, and is near the town line, on a small branch of Simes' stream. This pond is 100 rods long, 50 rods wide, and is of an irregular eliptical shape. Its bottom is covered to the depth of six feet with perfectly white calcareous marl of extreme purity, formed by myriads of shells of the cyclas and planorbis, an abundance of which are still living in the waters of the pond, and are generally found under loose stones. Around its shores there is much impure grey and blue limestone. The waters which flow into it transport some calcareous matter, but the action of water from a neighboring peat swamp appears to be the most active agent in supplying the shellfish with calcareous salts, from which they secrete the carbonate of lime composing their shells. On testing the water it was found to be charged with crenate, apocrenate, and humate of lime, and it contains, also, a notable proportion of ammonia. On evaporating a portion of the water a buff colored precipitate subsides, which contains the above mentioned organic acids, combined with lime and an excess of carbonate of lime which was originally held in solution by carbonic acid as a bicarbonate. On evaporating the water to dryness, and treating the dry residue with caustic lime, ammonia is given off as a gas. It is prob-

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able that the shell fish make use of the organic acids as food, and convert the lime into a carbonate forming their shells.

The pond is 350 feet above the plain of Colbrook, at Chamberlain's tavern, and may be drained by cutting a canal at the southern extremity for the distance of 40 rods. A drain 20 rods in length and 2 1-2 feet deep has already been made, and the pond was lowered by it about 3 feet, so that an abundance of marl could be obtained for making lime.

On sounding the pond it was found to be from 2 1-2 to 3 1-2 fathoms deep, and the marl varied from 2 to 6 feet in thickness, and covers its entire bottom, giving the basin the appearance of an immense white bowl. This marl has been converted into lime by a very simple process, by Mr. Beech, who resides in the vicinity.

It is burnt in a square kiln in layers, with wood fuel; a draught arch being made beneath it, so that the fire passes under the charge, dries the marl, and ultimately kindles the wood and converts the marl into good quicklime. The kiln was 5 feet high by 10 feet square, and it requires 3 days to convert the marl into lime. It is very pure, and makes excellent mortar, but from its finely divided state is more quickly air-slaked or carbonated than stone lime. Since the soil of this and the neighboring towns is calcareous, marl is not required for manure, and hence it is not used. Near the house of Mr. Jude Fairman we examined an extensive limestone deposit. The locality is 60 rods N. N. E. of his house. It is a grey and drab colored limestone, imbedded in mica slate, and is indistinctly stratified, the strata running N. E. and S. W., and inclining to the S. E. 55°. The bed is 30 feet wide and will furnish a weak lime, since it contains only about two-thirds of its weight of pure carbonate of lime. Perhaps it may serve to make hydraulic cement. If burnt very carefully, it slakes with difficulty into a granular mass, but if the heat is raised to whiteness, it melts into a slag or glass, owing to the formation of silicate of lime, iron and alumina, a fusible compound. This limestone extends to the northeastward, and comes out near the easterly side of the marl pond.

Limestone was also found at the outlet of the Fish pond, half a mile northeast from Fairman's house, but it cannot be conveniently drained so as to quarry it, since it is nearly on a level with the pond.

We visited Dixville Notch, a place described last year by my assistants. This remarkable gap in the mountains is very interesting and wild, and as the tide of travel sets to the northward, will become a place of resort for the lovers of picturesque scenery. It is nine miles east from Colebrook village, and is the pass by which teams go to Erroll, on their way to Portland. A new road was in progress when we were there, and is now completed. The former road was made too high up on the steep bank, and not unfrequently in winter the loaded sleds were precipitated from it into the valley below, to the no small discomfiture of the teamsters. The new road is constructed with much more skill, and is 30 or 40 feet lower down and well drained on its southeastern side. Its grade is so gentle that teams travel over it with ease.

The summit of this road is 835 feet above the plain of Colebrook. The direction of the pass is N. E. and S. W., and it is walled on both sides by towering ledges and pinacles of mica slate, which stand nearly vertical, and attain an elevation of from 600 to 800 feet from the road. (See view of Dixville Notch.)

The mica slate dips to the N. W. 80°. Dykes of basaltiform trap rock, intersect the strata near the middle of the notch, and large loose blocks of it are seen in abundance on its northwest side. This rock contains very large crystals of basaltic hornblende and glassy white felspar, and resembles volcanic rocks more than any others found in the State.

On the north side of this road, 40 or 50 rods back in the forest, is a ravine called the Flume. It was formed by the decay of a large trap dyke, the disintegrated particles of which have been removed by torrents. The chasm is 20 feet deep and from 10 to 20 feet wide, and is the channel of a stream of water, from whence it received its name. The trap dyke runs N. 30° E. and S. 30° W., and is 6 feet wide. It is slightly porphyritic, with felspar crystals, and is of a dark brown color. It divides into large cubical blocks, which form a series of steps, so that when there is but little water, a person may walk a considerable distance up the flume on them. The principal ledge at this spot is granite, which protrudes through the mica slate.

Near the summit of Dixville Notch, the streams flowing into the Androscoggin on the one hand and the Connecticut river on the other divide. During our stay in Colebrook, Mr. Messer, the post master of the town, and Mr. Parsons, who owns the marl pond, assisted in all our explorations and merit our thanks.

Messrs. Williams, Whitney and Channing having examined the country along the Canada frontier and to the sources of the Magalloway river, where the State borders on Canada and Maine, I decided to return to the southward, and explore rapidly a line of section across the Green Mountains of Vermont to lake Champlain ; this was effected, and much useful and scientific information was obtained concerning the mines, quarries, and the order of superposition of the rocks, which are the equivalents of those to the eastward of New Hampshire, in Maine. Not being willing to spare much time for explorations beyond the limits of New Hampshire, this section was made in a very cursory manner, but its outlines are correct. Many valuable minerals occur in Vermont which we were obliged to neglect for want of time. Those near the New Hampshire borders were examined with more care, the information concerning them being of value to the people residing near the Connecticut river. This section was carried through from Lancaster to Concord, St. Johnsbury, Cabot, Montpelier and Burlington. Returning, we took a more southern route and examined the country from Middlebury to Orford, twelve days being devoted to this work.

At St. Johnsbury much valuable information was obtained from Mr. Huxham Paddock, who has wrought many of the iron ores of New Hampshire, which he transports by teams to his furnace, from the distance of 14 or even 30 miles. (See economical geology, remarks on iron ores.)

At Thetford the processes in mining and working iron pyrites for copperas were fully examined, and statistical information was obtained respecting the business. The marble quarries of Middlebury were visited, and the information obtained will be consigned to the end of this report, with such other information as I have been able to obtain in former excursions into Vermont.

By throwing our sectional lines across Vermont, we have connected the surveys of the New England States with that of New York, and the other State geologists have carried

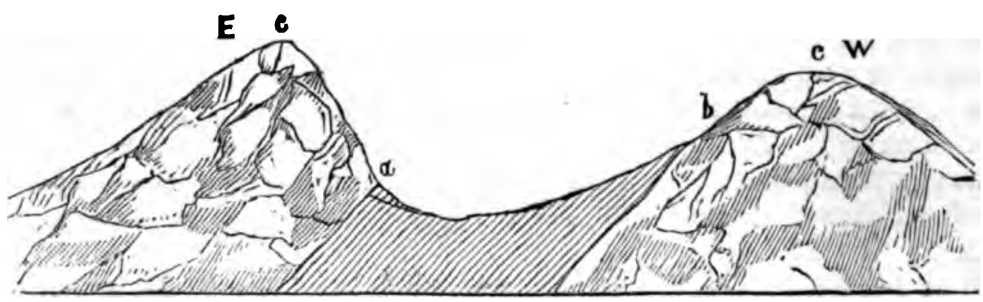
forward this line to the far west, thus making a continuous survey from Nova Scotia to the lake Superior. In a country whose geology is cast on such a grand scale, no thorough and general knowledge can be obtained of the great rock formations, excepting by extensive sectional examinations across very wide portions of the continent. (See remarks in the introduction to this report.)

Returning to Haverhill, I met Messrs. Channing and Hale, who had examined the northern frontier, and had made an extensive survey of the Canadian borders of New Hampshire and Vermont.

We then revisited the limestone beds near Black mountain, and searched for them near Haverhill corner, where it was supposed they would be discovered. It was ascertained that the intrusion of a large mass of trap rock had cut off the limestone, and had combined with much of the lime, small veins of calcareous spar being discovered where we expected the great bed of limestone, found near Black mountain last year, would be discovered. It is not improbable that it may yet be discovered at some intermediate points, where the soil now conceals it.

Leaving Haverhill for Littleton, we examined the limestones of that town, being assisted by George Little, Esq. Mr. Moses Little's quarry is situated 1 1-4 miles northwest from the village of Littleton, and is now wrought for lime. The bed is included in mica slate, embraced on both sides by granite, which crowded the limestone in such a manner as to produce contortions of the strata. The course of the limestone, as indicated by strata marks, is N. 20° E., S. 20° W., and its dip is to the N. W. This locality contains an inexhaustible quantity of good limestone, which can be easily quarried, the natural drainage being abundantly sufficient to keep the openings free from water.

The following wood cut represents the situation of this bed of limestone.



a. b. limits of the limestone bed, the walls being mica slate, which is also interstratified with the limestone. *c. c* granite rocks.

Two miles northeastward from this quarry, another one has been opened by Mr. John Clarke. The limestone is irregularly stratified. The general course of the strata marks is N. 5° E., S. 5° W., and its dip is W. 80°. This quarry is also wrought to some extent, and we had an opportunity of inspecting a kiln of the lime which had just been burnt. It was of good quality, and although somewhat brown colored, when slaked, became almost white.

Such information as concerns the statistics of the lime business, will be found in the economical department of this report.

Novaculite or hone slate is abundantly procured from the ledges of that rock in Littleton, on the estate of Mr. John Palmer.

The stone is quarried by Mr. O. R. Fyler of Bradford, Vt., who has purchased the privilege for ten years, and manufactures it into oil stones, which are of good quality, and are readily sold at 25 cents per lb. after being ground into proper forms.

The ledge affords several different varieties of hone slate, of various degrees of hardness and fineness. The blue kind, which is argillite, is the softest but not in so good repute as the greenish and buff colored stones.

The novaculite is regularly stratified, and its strata run N. E. and S. W., and dip to the N. W. 80°. On the surface of this ledge there are well defined and distinct drift scratches, which, on the westerly side of the hill, run N. 15° to 20° W., and S. 15° to 20° E., while on its eastern side they have the direction N. 15° E. and S. 15° W., the shape of the hill having produced this divergence in the drift.

Returning to the village of Littleton, we examined a peat bog on the estate of Mr. Joseph Henry, where, under a layer of one or two feet of peat, is a bed of the remains of siliceous infusorial insects, such as have been described by Erhenberg, Bailey and others. This substance is frequently mistaken for marl, on account of its being light, pulverulent and white. It consists of silex, water and the organic acids of mould, and may be distinguished readily from calcaceous marl by its not effervescing with acids. This infusorial silicia is from 6 inches to 1 foot in thickness, and underlays about three quarters of an acre of peat. It may be easily prepared, by washing and burning it, for tripoli or polishing powder, which is used for scouring brass and silver.

This bog can be perfectly drained at a trifling expense, and then may be cultivated, and will make an excellent grass meadow.

Another peat bog was examined on the estate of Mr. Eastman, in the south part of the town. It is extensive and deep but may be reclaimed.

Littleton is underlaid by argillaceous slate rocks, cut through by a few trap dykes. In the slate, crystals of quartz are found, some of which are very handsome. A fine group was presented to the State cabinet by Mr. Charles Lovejoy.

On passing through Franconia, we learned that the iron company had decided to alter their furnace, and to introduce the hot blast, and the smelting operations were, therefore, suspended. A granite quarry in Lisbon was mentioned as worthy of a visit, and was examined. It is on the estate of Mr. Joseph Jackman, and is about a mile from the iron mines. Large blocks of granite, 20 feet in length, may be obtained at this quarry, which is wrought to some extent, the stone being of excellent quality, insomuch that it is transported to the towns five or six miles around, and is used for underpinning and for hearth stones.

From Lisbon we went to Benton, and, in company with Mr. Moses Whitcher, examined the iron ores that have been discovered in that town, at a place called Bunga. The ore is the magnetic species, and is a vein from 6 inches to 3 feet in width and quite irregular, included in a rock composed of granular quartz and black tourmaline, and runs in a north and south direction.

This mine belongs to Messrs. David Clement & Co. of Bath, who have extracted a considerable quantity of the ore and sent it to the Franconia furnace, distant 10 miles, where it sold for $5 per ton. The cost of extracting it from the mines was $1 25 per ton. It is a good and rich iron ore, but the irregularity of the vein prevents any safe calculation as to the quantity of ore included in it. Although it is not worth the expense of putting up a furnace near it, still the mine is of value to the people residing in the vicinity, for it furnishes profitable employment when there is but little to be done in farming operations.

LANDAFF. In this town there are several veins of iron ore. On Cobble hill, near the centre of the town, small veins of magnetic ore have been discovered, and the compass is so much deflected by their attraction as to lead the people into a belief that there must be a larger vein than has yet been seen there, but this is a very inadequate reason.

The Chandler vein of iron ore, in the south part of Landaff, was purchased by the Franconia iron company in 1834. It is the magnetic species, and of considerable magnitude, being 8 feet wide and 130 feet long, but the ore is so mixed with brown magnetic iron pyrites, as to render it unfit for the furnace, since a portion of the sulphur, which remains after roasting and smelting, renders the iron "short" or brittle. I learned that the company paid $2,500 for the mine, and have expended $2,100 in working it, but have since abandoned it, on account of the difficulty above mentioned.

This vein runs northeast and southwest, and is included in mica slate rocks, with quartz. A little argentiferous galena has been found in this vein.

Yellow iron pyrites occur in the quartz veins one mile east from Mr. Page's house.

Sulphuret of molybdena, in crystaline plates and disseminated scales, was also observed. There is not a sufficient supply of the pyrites for the manufacture of copperas, the only economical use to which it could be applied.

Leaving Landaff, we visited Mr. David Clement, at Swiftwater in Bath, and examined a deposit of bog iron ore, near his house. This ore was sought for and wrought during the last war, and was reduced to loups of bar iron in a forge in Bath. The ore occurs in a swamp, comprising about 20 acres, and has about three feet of swamp muck over it. Lumps of good bog iron are obtained by digging, and by means of a crow bar the solid pan of compact bog iron is broken up and extracted. Beneath the pan ore is a bed of gravel, mixed with and cemented by the ore. The sluggish stream passing through it, deposits a layer of iron ore in its course. I advised the draining of the swamp previous to any further exploration, when it will be more easy to extract the ore, if it is found in sufficient abundance, and, if not, the land will be ready for conversion into an excellent meadow. Mr. Ezra Goodwin, who aided in examining this bog, says that he finds much good bog iron while ploughing his land, the ore being in large lumps. Returning to Mr. Whitchers, specimens of the hæmatite iron ore of Black mountain, in Haverhill, (which he had visited at my request,) were exhibited, and specimens were taken for analysis. This ore is of the best kind, and, if found in adequate quantities, will meet with a ready sale at the furnace. The vein does not appear to be large, probably not more than 8 inches in with. It is the botryoidal variety of brown Hæmatite, and contains 55 per cent.

of iron. It is found in quartz veins, and is associated with handsome crystals of quartz. Crystalized magnetic iron ore, in regular octahedrons, is also found about half way up Black mountain. A considerable quantity of white iron pyrites is found on the estate of Mr. Calvin Colby, in Haverhill, in mica slate rocks, accompanied by chlorite nodules.

From Haverhill we went to Orford, to examine the limestone, which is extensively quarried and burnt into lime in that vicinity, the principal beds being in the town of Lyme. These localites were visited in company with Dr. Hosford of Orford, who is well acquainted with the minerals that are found in his neighborhood, and has a small collection of specimens.

The limestone is found on the west side of Cuba mountain, and is opened in several places, having been wrought for twenty years. It extends along the westerly side of the mountain from Orford to Lyme. The beds have a north and south direction, and dip westward at an angle of 60° or 70° from the horizon. They vary from 1 to 20 feet in thickness, but often are so near each other as to be wrought in a single field. Thus, at L. F. Tillerson's quarry, the aggregate thickness of the limestone is 38 feet, one bed being quite near the other. The lowest bed runs N. 35° E., S. 35° W., and is 18 feet wide; the upper one is 20 feet wide. The strata marks indicate many flexures in the strata of this limestone, which is interstratified with thin layers of the kind of rock forming its walls. The limestone is granular, but does not crumble in burning. Specimens were taken for analysis, and an account of the business was obtained, which will be consigned to the economical department of this report. Dr. Hosford has discovered a number of very beautiful crystals of rutile, or red oxide of titanium, in the quartz crystals, which occur in the wall rock of the limestone at this place; also, separate crystals with the quartz and chlorite. It is not improbable that the splendid specimens of quartz containing acicular crystals of oxide of titanium, which have been found loose in the soil in the towns south of this place, were derived from the drifted detritus from these rocks. I have seen a specimen in the possession of Dr. Chilton of New York, and one in the cabinet of Dartmouth College, which were found in the soil not far south of this place, both of which are very splendid, and are highly valued by mineralogists.

A little south of Sunday mountain, in Orford, masses of tremolite have been found on the estate of Mr. Ezekiel Bailey, who gave me a specimen of it for the cabinet.

On the land of Mr. Jesse Gage, near Sunday mountain, there is a bed of talcose slate, which answers for soapstone. The bed runs N. E. by N., S. W. by S., and dips almost perpendicularly. It often contains some iron pyrites, which will injure its quality, but some good and sound blocks may be obtained.

In a part of Orford called Davistown, specimens of copper ores have been found. Those given to me were copper pyrites, black sulphuret of copper and green carbonate of copper. They accompany magnetic iron ore and sulphuret of molybdena. Small quantities of galena were also found in Quintown, a part of Orford. Hæmatite iron ore occurs on Cuba mountain in quartz veins, associated with crystals of quartz. Kyanite, in large bladed crystals, of a pale blue color, is also abundant. Specimens of these minerals were given to us by Mr. Perrin, and the locality was fully examined by Mr. Channing, one of my

assistants. In company with Mr. Jeremiah Marston, I ascended Cuba mountain, examined the iron ore and measured the height of the mountain.

By barometrical observations the height of the limestone quarry is 1321 feet, and the summit of Cuba mountain is 2273 feet above the ground at Orford tavern. Mr. J. Marston's is 621 feet above Orford village. By meridional altitude of the sun, the latitude of Orford village was found to be N. 43° 53′ 36″.

LYME. This town was partially examined last year, but much having then been left unexplored, was revisited for the purpose of completing the work. Aided by Dr. Hamilton, who has devoted a portion of his time to the examination of the minerals of the place, we visited every locality that was supposed to possess any mineralogical or geological interest.

On the farm of Mr. Charles Scott, beds of limestone have been found, which measure six feet in thickness. It is the granular crystaline variety. Associated with it, along the walls of the beds, large quantities of massive garnet occur, with crystals of hornblende, the mica slate passing into hornblende slate near the limestone. A very singular mixture of granular quartz and carbonate of lime is found on this farm. The bed runs north and south, dips to the west, and is 120 feet wide. It will furnish any desirable quantity for the manufacture of plate or window glass, to which it is well adapted. This rock had been mistaken for white marble. It is probable that this intimate mixture of carbonate of lime and granular quartz was originally a sedimentary deposit, but has since its original deposition been altered in structure, by the agency of igneous causes, the particles of quartz being too large to enter into chemical union with the lime, at the temperature to which it was exposed, or its origin may be accounted for by supposing carbonate of lime to have been deposited from mineral springs among the fine white sand during the period of its submergence. It is certainly a very remarkable rock, and has not been observed elsewhere in New England. (See analysis of this rock.)

On Holt's hill in Lyme we examined a locality of iron pyrites, which had been made the subject of a nefarious swindling speculation a few years since. A stranger having procured a bond of the mine, is said to have sent other persons to make offers of a very large sum for it, which induced the owner to redeem his bond at the cost of $500, when the parties, who had made proposals to purchase the place, disappeared, and have not since been heard from. It was evidently a conspiracy to plunder the original proprietor.

The mine, as it is called, is worthless, containing nothing more than the common variety of yellow iron pyrites with a narrow bed of granular limestone, one foot in thickness. An opening 15 or 20 feet deep has been excavated in the rocks, under the delusive hope of discovering ores of silver or gold.

On the opposite side of the road, on the hill behind Holt's tavern, another pyrites mine had been opened, with the same erroneous impressions respecting the occurrence of precious metals. This locality was examined by my assistant, Mr. Williams, who brought the specimens which he obtained to me, stating that there was not enough of the mineral to be of any value. It proved to be common yellow iron pyrites.

Among the minerals which are found near the base of Holt's hill, which will be sought

by mineralogists, is the splendid brilliant black tourmaline, which abounds in the white quartz, traversing it in long and well defined prisms, occasionally well terminated. Very handsome specimens are easily obtained by breaking up the numerous blocks of quartz which are found near the foot of the hill, just at the margin of the woods.

Since our examination of this town, Prof. Oliver P. Hubbard writes me he has found some crystalized sulphuret of antimony in the loose blocks of quartz near the locality above mentioned, and he supposes it may be found in place in the vicinity.

Canaan. This town was partly explored this year, but more thorough examinations of the mines and minerals were made during the third season of the survey. The rocks in the town are mostly granite and gneiss. Beryls are found in the quartz and in the granite. Iron and copper pyrites occur in veins, and associated with the brown pyrites, minute particles of metallic gold have been discovered, but in too small quantity to be of any economical value. (See analysis.) The copper pyrites is sufficiently rich in copper to work for that metal, provided an adequate supply of the ore could be obtained, but none of the veins that have yet been discovered are of sufficient magnitude to supply a copper furnace, and the rock is very hard, so that it will prove expensive to sink deep into the veins to ascertain if they prove wider as they descend into it. The copper and iron pyrites occur on Mr. Jacob Richardson's hill, three miles east of the village of Canaan, and has been mined to a small extent. The same vein extends to Grafton, where it is exposed near Pinnacle mountain, on the road side, and was examined during the third season of the survey. On the margin of Hart's pond, and over part of its bottom, there is a deposit of infusorial silica.

Yellow ochre has been obtained near Mr. Elijah Whitcher's, at Orange corner. Four and a half miles from Canaan village, in Orange, on the west side of the turnpike and near the summit of the elevated land, which divides the waters flowing into the Connecticut from those which flow into the Merrimack, a series of deep pot holes occur in the solid granite rocks, one of which, from its great depth and perfect regularity, is called the well. It is 4 1-4 feet in diameter at the top and 2 feet at the bottom. One side has been broken away, so that a concave portion of a semi cylinder is seen. From the top on that side to the bottom of the well the perpendicular depth is eleven feet, and on the opposite side, where the surface is level with the road, the depth is eight feet. The abraded surface or interior of this ancient pot-hole, is polished smooth, having the same appearance as is observed in those of more recent origin at Bellows Falls. The inhabitants of the neighboring village had cleared the rocks, soil and water from this well for the sake of inspecting it, so that a good opportunity was offered for a full examination of its surface and depth. I was informed that the stones which were found in it were rounded and polished, resembling those usually found in the pot-holes at Bellows Falls.

On exploring the immediate vicinity, we found a great number of more shallow holes of a similar nature, and on the surface of the rocks, where they had been recently uncovered, numerous drift scratches were observed. On examining by the compass the direction of the pot-holes, they were found to range parallel to the drift scratches, or N. 10° E., S. 10° W., indicating that they were produced by the same current that excavated these deep

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cavities in the rock. On the eastern and western sides of this mountain pass there are rocky hills, but no stream of water originating from them, has passed over this spot, which is the summit dividing the tributary streamlets of the Connecticut and the Merrimack, and is from nine hundred to one thousand feet above those rivers, or 1229 feet above the sea. No pot-holes have been noticed as belonging to the drift epoch, and the absence of them has induced some geologists to deny that water was concerned in the drifting of soils and stones from north to south. Hence this discovery will be regarded as one of great interest, for not only does it prove that waters formerly rushed over these rocks in this elevated mountain gap, and that a series of rapids and water falls existed there, but since the excavations are much deeper than have been formed by the falls of any of our modern rivers, a much longer time must be allowed for the continuance of the ancient currents that produced them. The rock is as hard as that at Bellows Falls, where it is rare to find pot-holes more than three feet deep, and yet those falls have been in operation from a period long anterior to the creation of man, having begun soon after this portion of the continent was elevated from the ocean's level to its present height. In order that any river should pass through this gap, a totally different configuration of the country would be required. The Connecticut or Merrimack rivers would have to be raised 1000 feet in order to enable their waters to discharge themselves over these mountains. The occurrence of an ancient glacier might have given rise to a waterfall, but glaciers are not sufficiently stationary to produce any such effects. I am disposed to regard the phenomena above described as having been the result of the long continued action of a river flowing through the gap at a time when the land had not attained its present elevation above the sea, and presented a different configuration, giving a corresponding direction to the streams.

View of the well or pothole in the granite of Orange, on the height of land dividing the Merrimack and Connecticut rivers. The upper part presents the remains of one half of the cylindrical cavity, the front portion having been split off by frost and lost by removal or disintegration From the level of the road the perpendicular depth of the well is 8 feet. Its diameter at top 4 feet 4 inches; at bottom 2 feet. When first discovered it was full of smooth round stones and soil.

Since this discovery, I have learned from Mr. John McDuffie that ancient pot-holes have been found between Plymouth and Wentworth, three miles from the latter town. Also, near

Winchester, where they were noticed by Mr. Evi Pierce; and also in Vermont, near Onion river. I have no doubt that they will be found in numerous other places, when attention is called to the subject, for they may be easily overlooked when full of soil.

Grafton. About a mile and a half from the pot-holes of Orange, there is a very valuable quarry of mica, which is extensively wrought by Mr. Ingalls, a mica dealer of Boston. The place is called the Glass hill. This hill is about three or four hundred feet above its immediate base, and is composed of a very coarsely crystalized granite, which is a vein in mica slate. The mica is very clear, transparent and colorless, or when in thick masses has a delicate red tinge. The felspar is of a beautiful white color, and contains both soda and potash. The quartz is colorless and has a greasy lustre, and occurs in singularly modified crystals appearing as if compressed by the mica. Crystals of black tourmaline occasionally are found compressed between the lamina of the mica. Large and very thin plates of compressed felspar and mica are also found between the lamina of the mica plates, like those previously noticed at Alstead. Blue and green phosphate of lime also occurs, but are rarely well crystalized.

The quarry has been extensively opened on the southeast side of the hill, which is very steep, and allows the rubbish thrown out in blasting to roll out of the way into the forest below.

Mr. Ingalls had obtained about sixteen tons of mica, which was packed up in boxes and stowed away in a neighboring barn. Each box contains about 600 weight of mica, hence the amount then quarried and on hand was 32,000 pounds. There is, however, much lost in trimming and preparing it for market, so that probably not more than half this quantity will be sold for stove or lanthern windows. The small mica and trimmings sell for a low price, being used with gypsum for filling the interstices between the walls of the iron safes for banks and counting rooms.

The view from the Glass hill is very picturesque, an abrupt precipice, too steep for ascent on the northeast, descends into a dark copse of woods, while to the south, an extensive panorama of mountains and undulating hills is seen covered with green woods and interspersed with a few cleared valleys. Having devoted as much time to this town as could be spared from other sections, it was decided to revisit other parts of it during the next year, and we, therefore, went to Concord, and then explored a range of towns near the southern boundary of the State.

Amherst. In this town we examined a bed of limestone, which was first noticed by Dr. Spaulding, whose attention was called to it by observing masses of limestone in the stone walls. The limestone was found in place included in mica slate rocks, in a deep ravine near the Bedford line, on the estate of Widow Betsey Stevens. It is 6 miles N. N. E. from the village of Amherst.

In company with Dr. Spaulding and Mr. Peabody of Amherst, we examined this locality, and discovered a few rare and beautiful minerals associated with the limestone and in the rock including the bed. The limestone is highly granular and white, and has mingled with it small grains of a mineral called pargasite, a variety of pyroxene. It is divided into several beds, from a few inches to three feet in width, and follows the course of the ra-

vine in a N. by E., S. by W. direction, and dips to the west 85°. It will make a good and strong lime, suitable for mortar and agricultural purposes. It is exactly like the limestone of Phipsburg, Maine, and has associated with it the same minerals.

Large crystals of egeran, some of which were 4 inches long and 2 1-2 inches in diameter, were obtained by breaking off masses of the wall rock with a crowbar. Smaller crystals, which are very perfect and resplendent, are found in the quartz. Their color is of a deep red brown with a tint of yellow, and some of them are irridescent. Their form is that of a right square prism, with its lateral and terminal edges and solid angles replaced. A figure of one of the crystals furnished by me may be seen in J. B. Dana's Mineralogy, page 381.

Large crystals of yellow or cinnamon stone garnet were also discovered in the limestone and in the quartz on its borders. The most perfect are found in the quartz. The largest have rarely smooth planes, but their dimensions are extraordinary, some of them being three or four inches in diameter. They are crystalized in regular rhombic dodecahedra, and rarely are replaced on their edges by single planes. This new locality of minerals will attract numerous mineralogists to the place.

Large crystals of amethystine quartz, three inches in diameter and eight inches long, have been ploughed up from the soil in Amherst. A splendid specimen was presented to me for the State cabinet, by Mr. Jotham Hartshorn of Amherst. They were discovered two miles west of the village. Crystalized magnetic iron ore, from one to two inches in diameter, exhibiting the passage of the octahedron into the rhombic dodecahedron by decrement from the edges of the primary form, are found in abundance on the farm of Dr. Spaulding. They are contained in granite rocks, and fall out by its disintegration, and are dug up from the soil.

Bog iron ore is found in the east part of Bedford, on the land of Hon. Thomas Chandler, and has been wrought at the Chelmsford furnace. It is also found in Amherst, on the estate of the late Mr. E. Blanchard, and in Merrimack, in the northwest part of the town, on the land of Mr. John McConihee.

A chalybeate mineral spring, of some repute, was visited. It is two miles east from Hon. Charles H. Atherton's house, on the estate of widow Boutelle. A bottle of it was obtained and examined by chemical tests. It was found to contain carbonate of iron, bicarbonate of lime and a little crenic acid.

The water is very cold in summer, and bubbles of gas are continually rising through it. It possesses slight tonic properties and is a place resorted to by a few invalids.

While on an excursion to New Boston with Mr. Atherton, I found, among a lot of iron pyrites in possession of Mr. Moses Wood, a large piece of the red oxide of titanium, which was previously supposed to be a refractory iron ore. On inquiry, I learned that it was dug up by Mr. Samuel Goss, while building a saw mill for Alexander Wilkins on the Souhegan river. Since then specimens have been obtained from Mr. Goss, and a quantity of the mineral has been deposited with a druggist for sale. It is used for giving a delicate straw yellow color to porcelain, and is in this country used by dentists in coloring artificial teeth, which are made chiefly of semi-vitrified felspar. About a dozen pounds of this titanium ore has been brought to market.

Felspar, suitable for porcelain, occurs in the coarse granite veins on the Souhegan river, but it is not so easily obtained as at the mica quarries.

Amherst is underlaid by granite rocks so far as can be observed around the margin of the plain or valley in which the village is situated. Its soil is a sandy loam of aqueous deposition, derived from ancient drift from the north, the valley, as suggested by Mr. Peabody, having been a great basin.

Leaving Amherst and travelling through Milford, Wilton, Peterborough and Dublin, to Keene, the limits of the rocks were sketched, and specimens obtained. In Milford the same kind of granite that occurs in Amherst abounds, and mica slate rocks were not observed until we had reached Wilton, where the strata dip to the southwest. Beds of brick clay were noticed in this town, and the soil was found to contain a considerable proportion of argillaceous matter, so as to be retentive and good. It is a rich brown loam.

Peterborough is a prosperous manufacturing town, but has no minerals of economical value. Near Dublin, one mile from a place called the Harbor, several varieties of paints have been obtained, and are prepared for sale by Mr. Sawyer, who has disposed of several wagon loads of it. He furnished me with specimens, which are of various shades of brown, from a deep umber to a light sienna. They consist of a variable mixture of oxides of iron and manganese, combined with the organic acids of the soil. By finely pulverizing and washing out the fine particles, and allowing them to subside, some very good paints may be easily prepared, and by roasting them at various degrees of heat, a number of different shades of color may be produced. The manganesian paint or umber has the property, when ground in oil, of drying very quickly, and is sought for by carriage painters. The prepared colors were sold by Mr. Sawyer for 10 cents per lb., and they have been used to some extent in Claremont. Bogs of peat were observed near the road through Dublin, and the peat may be economically employed in making compost for agricultural use. Drift scratches are common on the rocks, and run north and south.

In Keene, I visited the New Hampshire window glass works, and obtained much information, through the politeness of Messrs. Elliot & Holman. They have made use of the Acworth granular quartz, which makes good glass, but requires more alkali than that from Vernon, Vt.

Milk quartz has also been obtained from Alstead, twelve miles from Keene. It is found on the estate of Mr. Stearns. Some specimens of the N. H. Co. glass, furnished to me, were subjected to a rigorous trial in my laboratory, and were found to withstand chemical reagents remarkably well, and is nearly as difficult to melt as the Bohemian chemical glass.

When the N. H. glass works were first erected by Schoolcraft they proved unprofitable, but the workmen now employed having thoroughly learned the business, the establishment is doing well.

A large supply of excellent window glass is now furnished to citizens of New Hampshire by these works, and is sent to stores in various parts of the State by the company.

Leaving Keene we went to Sullivan, observing on the way that the rocks were gneiss, the strata of which dip to the southeast. Succeeding this rock is mica slate, charged with decomposing iron pyrites, which gives the rock a brown color.

In Nelson, Messrs. Nimes, French, Rev. G. Newall and Dr. Rand, accompanied me to all the localities they wished to have examined.

Several small beds of plumbago, or graphite, have been wrought in this town. One on the estate of Mr. Newall is about 1-4 of a mile from the M. H., and is included in strata of decomposing pyritiferous mica slate. It is soft and foliated, so that it is difficult to obtain solid pieces. The vein is from 6 inches to one foot in thickness, and runs N. by W., S. by E., and dips to the westward. It was discovered in making the road, and eight or ten tons of it have been extracted and sent to market, but did not sell readily on account of accidental impurities.

From this mine, we went to Pinnacle hill, a naked rock of granite and mica slate. The surface of this ledge is marked by an abundance of drift scratches, which run S. 25° E. A few small beds of good plumbago have been found in this hill, but they are not wide enough to repay the expense of mining.

Leaving the Pinnacle, we crossed through the margin of the woods to Mr. Horatio Osgood's plumbago mine, a little north of Pinnacle hill. This mine has been wrought to considerable extent, and has, in three months, furnished 30 tons of plumbago. The right of mining was let to Mr. David Lowe of Hancock, who paid five dollars per ton for the right, and employed three men in the work.

Mr. Otis Barden of Hillsborough also took a lease of the mine at the same rate, and extracted 10 tons of plumbago, which was transported to the Hillsborough mills, (distant 20 miles,) ground and sold in Boston.

In the northeast part of Nelson, bog manganese is found on the estate of Mr. Isaac White, who furnished specimens of it for examination. It will answer for umber paint, and will generate chlorine by decomposing muriatic acid, but will not serve for the preparation of oxygen, on account of the organic acids which exist in it.

Hancock. In this town we examined Symmes' hill, which is a rocky eminence elevated 496 feet above the level of the village. The rocks are coarse pyritiferous granite and mica slate, with veins of milk quartz. No important minerals were found. On Miller's hill there are some narrow beds of plumbago about an inch wide, which occur at the junction of the mica slate with the granite. During our stay we were kindly assisted by Mr. Stearns, the preceptor of the Academy, and by Mr. Patten.

Continued stormy weather, with heavy snow squalls now set in and put an end to further researches for the season.

THIRD YEAR'S SURVEY.

During the summer of 1842, the geological examination of the State was continued, and the towns which had not been previously visited by me were examined so far as was practicable. Several mines of importance were re-examined, especially where new openings furnished better opportunities of learning more thoroughly the nature of the ores, or admitted of estimates concerning the probable value of the mines.

From Concord our first excursions were directed towards Portsmouth, where the barometers were compared, one of them being left in the care of Mr. C. W. Brewster, who had the kindness to make the requisite observations and publish them in his paper, the Portsmouth Journal, which being transmitted to me every week, enabled me to calculate the heights of the various places visited, as the work proceeded. The tables of barometical observations made at Portsmouth and in various parts of the State at the same times, will be appended to this report.

Epsom. A desire having been expressed that the minerals of this town should be examined, an excursion was made thither for the purpose. On leaving Concord, the deep drift deposits of sand filling the Merrimack valley were observed to extend through Pembroke to within six miles of Lock's tavern, in Epsom, where the granite rocks appear above the surface of the soil, and the hills are covered with innumerable angular erratic blocks and smaller rounded boulders of granite. Beyond the granite, gneiss and mica slate strata appear, having a northeast and southwest course.

On Mr. Lock's farm, terra di sienna was formerly obtained and prepared for market, but owing to the low price of the article, it is not wrought at present. According to an Indian tradition, lead ore was supposed to exist on the land of Mr. Hersey, but no evidence of the fact could be obtained, none of the people, after diligent search, having found any there. The rocks at that place are mica slate, which dip boldly to the westward, at an angle of eighty degrees from the horizon.

On visiting Mr. Goss, who has devoted some time to searching for minerals, specimens of arsenical pyrites, with a little galena and iron pyrites were seen, and, guided by him, we visited the localities where they were obtained and procured specimens.

One of the localities is directly in the rear of his house, on a hill of granite gneiss. The veins are from one half of an inch to one inch in width, and run N. E. and S. W., and

consist of arsenical pyrites and argentiferous galena. They are too narrow to be of any economical value.

Large nodules of arsenical pyrites also occur on the estate of Jonathan Goss, in veins of quartz, which are from two to three feet in width, and pursue an east and west course, and dip to the S. 45°. This vein is exposed in the bed of a brook for the distance of about thirty yards. The arsenical ore is very brilliant and silvery white, hence was well adapted to excite unfounded expectations of its being an ore of a more precious metal. On the estate of Mr. Hopley Yeaton, on Brush hill, in a ledge of coarse granite and quartz, nodules of arsenical pyrites, of large size, are found associated with silvery white mica, and in considerable abundance.

Masses of bog iron ore are obtained from the deposit formed by a chalybeate spring on the estate of Mr. Goss, the spring being charged with carbonate and crenate of the oxide of iron. A few masses of hæmatite have also been found associated with quartz crystals.

McCoy and Fort mountains are both composed of mica slate rocks, containing a variety of kyanite, commonly called fibrolite, with garnets and black tourmaline. The compass being attracted by the rocks of these hills has led many to suppose that iron ore might be abundant. This is not necessarily the case, for particles of magnetic iron pyrites disseminated in the rocks often produce this effect.

McCoy mountain is 324 feet high from its base at Mr. J. Goss', or 1590 feet above the sea level.

Fort mountain is 466 feet high, above the same place, or 1869 feet above the sea.

From Epsom, we went to Epping, and on the way examined the veins of granite which intersect the gneiss and mica slate.

One of these granite veins may be seen half a mile S. E. from Mr. Timothy Batchelder's house. It runs N. W. and S. E., or nearly at right angles with the gneiss strata. On the surface of the whole ledge numerous drift scratches and furrows may be seen. They are very distinct, being from 1-4 inch to 7 inches in width and half an inch deep. Their course is S. 35° E.

In Raymond, mica slate ledges abound, their strata dipping to the southeast on one side of the hill, and northwest on the other. Large erratic blocks of granite are abundantly scattered over the surface of the rocks in place. One of them, measuring more than twenty feet in diameter, was observed near the road to Epping.

The strata of mica slate run N. 35° E., S. 35° W., and dip 70° to the S. E.

Pittsfield was examined by my assistant, Mr. Channing, who reports that the rocks are coarse granite and gneiss, passing into mica slate.

In Wild Goose pond, according to the statement of Mr. John T. Tucker, large masses of bog iron have been found.

Mr. Jonathan Chase exhibited some large tiles of mica slate, with silvery white mica and crystals of macle, which he obtained from this pond. The same mineral was also found in a neighboring ledge. On the land of Mr. Tucker, four miles southeast from Pittsfield village, bog iron ore occurs, covering about an acre of land, irregularly varying in its thickness, not being generally more than three inches.

Half a mile northeast of the village, a chalybeate spring exists, and is said to have a sulphurous odor. Thirty years ago it had some celebrity as a mineral spring, and was much frequented.

Black tourmaline and some magnetic iron ore occur in this town. The soil is good, produces an abundance of wheat, and is good grazing land. Some attention has been paid to reclaiming peat bogs, and Mr. John Berry has converted one into excellent meadow, producing three and a half tons of hay to the acre.

Mr. Channing ascended the highest of the Catamount hills and measured its altitude barometically. It is 710 feet higher than the ground at Pittsfield tavern, or 1415 feet above the sea.

The summit of this mountain consists of gneiss and coarse granite. It is covered with forest trees, excepting at the summit, where a fine view of Monadnock, Kearsarge, Moosehillock and the White Mountains may be obtained.

Barnstead was also examined by Mr. Channing, who describes the face of the country as hilly and rough, but the soil is very good. The rocks are alternations of a very coarse felspathic granite, with gneiss and mica slate. Loose masses of basaltic trap rock are found near the road from Pittsfield to Barnstead.

A specimen of plumbago was obtained from Mr. Jonathan Kenniston, who found it in the ledges on his land.

On Mr. Tuttle's farm, a quarter of a mile west from Barnstead centre, bog iron ore occurs beneath the turf over an acre of land, but the deposit is not uniform or thick.

Bog iron is also found on the land of Samuel Garland, in the east part of the town, on the slope of a hill, forming a crust of two or three inches in thickness, underlaid by hard pan. It is not sufficiently abundant for a furnace, but serves, when ground, for paint. Yellow ochre occurs on the town farm. Black tourmaline is abundant in the granite.

Strafford. The same kind of rocks that were noticed in Barnstead, occur in this place. The Blue mountains traverse the town, and by Mr. Channing's barometical observations are 403 feet high above Mr. Wingate's, or 1151 feet above the sea. The peak of this mountain is within the limits of Farmington, and consists of gneiss.

From Epping, we passed through Greenland to Portsmouth, where our barometers were compared. A few excursions were made in the vicinity, in company with Mr. John L. Hayes, who had discovered a deposit of tertiary clay containing marine shells, in the south part of the town. The shells were found 15 feet below the surface of the ground, and 30 feet above high tide, in blue plastic clay. They are the nucula and sanguinolaria, with some few recent species. The ravine where they were dug up is bounded towards the sea by a ridge of land, in rear of which the clay was deposited.

Passing through Rye, the gneiss which supports the slate rocks, was observed to dip beneath it to the southeastward at a bold angle. Numerous trap dykes were noticed traversing the hard clay slate rocks.

Hampton and Kensington offered no objects of geological interest, and were passed

through hastily. They are agricultural districts, and the soil is fertile and well managed by the farmers.

In Kingston, we were desired to spend a day, and were aided by Dr. Levi Bartlett and Mr. Moses Sanborn in examining the rocks and soil. In East Kingston, the rocks are gneiss and mica slate, which are cut through by trap dykes containing carbonate of lime. Arsenical pyrites also occurs on the estate of Mr. Stevens, directly in the rear of his house. Peat abounds in the swamps in the northwest part of the town, where there are about 100 acres of it suitable for cultivation or for making composts. A small bog on Mr. Magoon's land had recently been cleared and cultivated, and presented some interesting appearances, showing the importance of alkaline and earthy admixtures with the peat, which alone is quite barren, being naturally very corrosive, from the presence of sulphate of iron, as determined by analysis. (See agricultural remarks.)

On the land of Mr. Morrill, there is an extensive peat swamp which extends in a N. E. and S. W. direction, reaching from Powow river to South Hampton.*

A rock supposed to be limestone, was examined, but it proved to be a singular porphyry, which turns white by atmospheric exposure.

Leaving Kingston, we passed through Derry, and from thence to Manchester. The rocks on the way were mica slate, dipping to the northwest, and gneiss with numerous drift scratches, having a direction S. 15° E. Boulders of porphyritic granite, such as occur in place on the westerly side of the Merrimack river, were observed scattered over the fields.

In Manchester, there is but little of geological interest, the rocks being a hard kind of gneiss and granite, in which some large crystals of magnetic iron ore are found, some of which weigh more than a pound, and are in octahedral forms with striated planes, indicating the passage to the rhombic dodecahedron. The best specimens were found on the land of Mr. Robert Baker.

Manchester is a very flourishing manufacturing town, traversed by the Concord and Boston railroad, and may be called the Lowell of New Hampshire. Its situation is salubrious and it will ultimately become one of the most populous places in the State. Among the improvements which have been made in the town, the public cemetery is deserving of the attention of travelers. It is a beautiful grove with a deep ravine traversed by a rivulet, and tastefully intersected by winding paths which conduct through all parts of the enclosure, being arranged somewhat like the Mount Auburn cemetery, but thus far, I am happy to say, having but few occupants. It is a monument of good taste, worthy of the factory corporations and the people of the town.

From Manchester we traveled through Bedford, and re-examined the limestone of Amherst, employing a man to open the bed and blast out some good specimens of the interesting minerals discovered there last year. A large bed of pure milk quartz was discovered lower down the ravine, suitable for making glass.

The banks of the Souhegan river were searched for titanium ore, but the height of the water prevented blasting to obtain specimens. It was first discovered at Wilkins' mills.

A locality in Lyndeborough, which was supposed to be a bed of white marble, was ex-

* I have recently learned, through the politeness of Dr. H. E. Perkins of Newburyport, that a fine moulding sand is found near the Powow river, on the land of Mr. E. French, who manufactures it into Bristol brick, by mixing it with pipe clay, brought from Martha's Vineyard, and then baking the bricks which are made of this mixture.

amined, and proved to be an immense bed of milk quartz of great purity, suitable for making glass. It is on a hill near Dea. Putnam's house, and not far from Tarbell's tavern.

The bed is included in gneiss, and is 90 feet wide, 300 feet long and 200 feet high. It extends to Temple, where I again noticed it. This rock may be transported to the Pembroke glass works, and made into window glass like that made at the N. H. glass works in Keene. The distance is 30 miles.

Bog iron ore is found in the southeast part of Lyndeborough, on the land of Mr. Oliver Pelham. It was formerly wrought for iron, but the supply is too limited to supply a furnace.

Trap dykes and granite veins are observed in the mica slate rocks, 3 1-4 miles northwest from Milton, on the Souhegan river.

In Lyndeborough, the farm of Mr. David Stiles attracted our attention, since he has made some improvements in the management of peat lands, after the method recommended by Mr. Elias Phinney in my reports on Maine and Rhode Island, and has been decidedly successful in his enterprise. (See agricultural observations.)

Temple. On reaching this town we called on Dr. Kingsbury, who kindly assisted in examining the few localities of interest in the neighborhood. With him we examined Spofford's or Temple mountain, an elevation 814 feet higher than the ground at Whiting's hotel, or 1755 feet above the sea. This mountain consists of Mica slate and gneiss, the strata of which dip to the northwest. No minerals of economical value were observed.

Leaving this place, we rode to New Ipswich, which had previously been examined by my assistants, and then traveled through Rindge, Fitzwilliam, Troy, Marlborough and a part of Swanzey to Keene, marking on the geological map the kind of rocks observed on the way.

For the first part of this section mica slate was observed, dipping to the eastward, having granite veins crossing the strata in a north and south direction. Then between Rindge and Fitzwilliam porphyritic granite, forming large veins in gneiss rocks, was noticed, some of them being nine feet wide. The gneiss dips to the W. S. W.

Near Troy, drift striæ are common on the ledges, and have a direction of from south 8° to 15° east. Near Keene, the mica slate runs N. 5° W., S. 5° E. and dips to the S. 80° W.

Leaving Keene, for Richmond and Winchester, it was observed that granite rocks extended through Swanzey to Richmond, and contained numerous nodules of foliated magnetic iron ore, that were examined during the first season of the survey.

Richmond. The land in this town is hilly, but none of the elevations are of sufficient height to receive the appellation of mountains. The rocks are granite, mica slate, hornblende rock and talcose rock or soapstone. The latter occurs imbedded in the mica slate rocks in the southeast part of the town, on the estate of Mr. Lorenzo Harris, and has recently been quarried for the purpose of obtaining the soapstone.

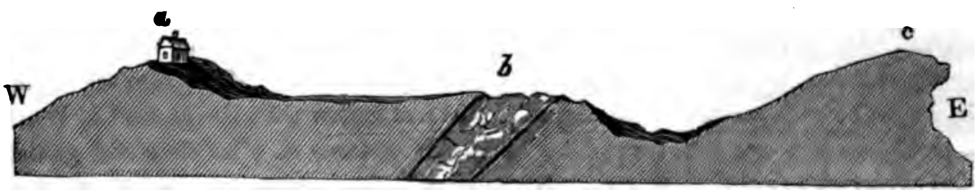
This locality was visited and examined with attention, since it furnishes several rare and interesting minerals. The soapstone bed is two miles S. W. by S. from Richmond meeting house, on the south side of Roaring brook, and one mile from the Massachusetts

State line, and on elevated land. It has a north and south course and dips W. 45°. The bed is 42 feet wide, and has been traced for the distance of a mile on the hills to the southward, or to the State line. The quarry may be drained from 80 to 100 feet. The talcose rock, or soapstone, is not stratified, but crystaline, being made up of interlaced crystals and laminæ of talc, with occasional fibres of hornblende. Some of it contains iron pyrites, but good blocks have been sawed out which were free from it.

When there is much hornblende or pyrites in it there is more difficulty in sawing it, and sand with a plate of iron is used to divide the hard points.

The best blocks are sufficiently good for the purposes to which it is commonly applied, while the hard variety is only fit for fire places, ordinary hearths and chimney backs. The quarry has been sold to Messrs. Lewis & Wright of Worcester, Mass., for $500, conditionally.

The following wood cut represents the situation of this bed of talcose rock:



Hornblende rock, Richmond, N. H.
a Alonzo Harris' house; *b* Soapstone; *c* hill of Hornblende rock.

In opening the quarry, the following accompanying minerals were thrown out, and were derived from the wall rock of the bed—quartz, felspar, phosphate of lime, pinite, rutile, iron pyrites, garnets, calcereous spar and hornblende crystals. In the hornblende rock very perfect crystals of black tourmaline, well terminated, are found abundantly, and are easily detached and quite perfect. Anthophyllite and iolite, of great beauty, are found in the quartz, and in the mica slate, where it passes into hornblende slate. Iolite is a rare mineral, and no other locality in this country furnishes so finely colored specimens as this spot, which will be frequented by mineralogists who may seek for specimens for study. It is exactly like that found in Norway, and if it could be obtained in perfectly solid pieces, free from flaws, would be valued in jewelry, since it has exactly the appearance of sapphire, being called by the French jewelers, *sapphire d'eau*. It possesses dichroism with a pale sky blue color in one direction and a violet in the other, so that its hues vary with the direction in which it is cut by the lapidary.

Surface pieces, being all we could obtain during our short stay, were much cracked by the influence of fire and frost, but on blasting to some depth finely colored and compact masses will be obtained.

At this locality, the iolite is exclusively the anhydrous species, never passing into chlorophyllite. (See analysis of this mineral.)

WINCHESTER. The western part of this town was explored on a former occasion, but the village was not visited. This season we endeavored to complete the examination of the town, and were assisted by Mr. Evi Pierce and Mr. Severance, who are both amateurs in mineralogy, and rendered very cheerfully their aid. Half a mile east of Mr. Pierce's house, a hill, containing an abundance of fine granular quartz, was examined. It is very friable, crumbling readily upon pressure, and contains a little mica, but is sufficiently pure for making bottle glass and sand paper. The purest masses would make good window glass. The quantity is inexhaustable. It has not yet been wrought, and may prove purer as it is opened by quarrying.

Large crystals of felspar and garnets are found in the coarse granite veins which traverse this hill. One of the garnets in possession of Mr. Pierce, is two inches in diameter, and is replaced by facets parallel to the planes of the primary rhombic dodecahedron. It is of a dark brown red color, and not transparent enough for jewelry.

While I was engaged in examining this locality, Mr. Channing, assisted by Mr. Severance, explored the iron ore hill, which he describes as follows:

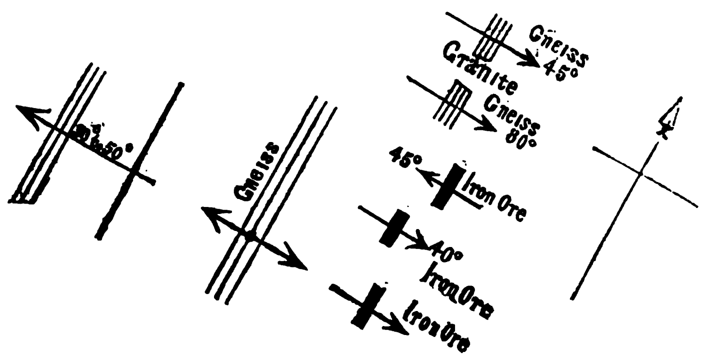
"The iron ore veins, or beds, are situated a mile and a half S. S. W. of Winchester meeting house, on the slope of a high hill, and near its summit. Excavations have been made in two places, but have been abandoned for more than 40 years.

The course of both the beds is about N. 10° E., S. 10° W.

The dip of the ore first visited was from 30° to 50° W. It had been excavated about eight feet deep for the distance of 200 feet.

The walls of the bed seemed to be five or six feet apart, but the accumulation of mould and soil for so many years rendered it impossible to see the whole floor of the bed. Trees, estimated to be thirty years old, were growing in the excavation. The wall rock is gneiss. The ore seemed to be in plates parallel with the strata of gneiss, and the whole bed of ore was interposed between the strata, their course being in the same line.

About thirty yards east of this excavation there is a naked ledge of gneiss in which the strata appear to be parallel to the surface, and dip E. and W. in different places.



Ground plan of the iron ore beds on Iron Ore hill, Winchester.

Proceeding about thirty rods east of the first excavation, we come to the second, which is on higher land. Here has been an excavation of 200 feet in length, from north to south, and

30 or 40 feet from east to west. A portion of the bed at the northern part dips 45° W., but this would seem to be an accidental displacement, for the rest of the bed dips 40° E., and all the neighbouring ledges have an easterly dip.

The mass of ore is very great, but the irregularity of the dip prevented its accurate measurement, though it occurs in the whole width of the excavation, from 30 to 40 feet.

It will be seen from the foregoing ground plan, and the following section, that if the dip is considered, the ledge of gneiss, which is mentioned as between the two beds, must be on the anticlinal axis, and the beds of ore may be portions of the same bed, or of parallel beds, bent over into their present positions. To establish this, however, requires more minute observation than could be given at this time.

On the ground plan, north of the second bed, are representad two ledges of gneiss, one about 100 yards north from the ore bed, the other 200 yards north, dipping eastward. A vein of coarse granite occurs between them. Other ledges farther north were examined, and all had an easterly dip.

The section below, represents the strata on the supposition that the gneiss at *a* is an anticlinal axis for the ore beds and neighbouring ledges:"

The beds of iron ore are represented by the sign for Mars, and the beds which should correspond with those discovered, and which are yet unknown, have the point of interrogation placed under that sign. The known beds are marked in black; the supposed ores are indicated by lighter marks.

The iron ore obtained from these mines by Mr. Channing is the magnetic species, very compact and heavy, having a steel grained fracture, and is laminated in thick strata, which are parted by a thin layer of mica. There is much good ore, free from sulphuret of iron, but occasionally a little iron pyrites is found with it. This may have caused its abandonment by the Rhode Island people, who first smelted the ore. I have no doubt that if it is well selected and roasted before reduction, it will make good iron, and the quantity is so enormous as to warrant a new and more thorough trial. I learned that forty-nine years ago, (when the art of smelting iron ore was but very imperfectly understood,) in this country, Messrs. Hawkins, Jenks, Arnold & Cahoon built a furnace in the west part of this town, still called Furnace Village, and manufactured hollow ware. The reasons for abandoning it are unknown to me. (See analysis of this ore.)

Gray and red silicate of manganese, or photozite and rhodontite encrusted with a thin layer of black oxide of manganese, were found abundantly on the top of Stony mountain, two miles southeast of Winchester meeting house. The ore is a bed in gneiss, having a N. 30° E., S. 30° W. course, and dipping eastward at an angle of 79°. It is 7 or 8 feet in thickness, and has been uncovered for the distance of 12 feet. It was formerly supposed to be an ore of iron, and a cart-load of it was carried to an iron furnace to be smelted,

but a quantity of it being melted into slag, or glass, in a forge, was placed under a hammer to be forged, when it was scattered in innumerable fragments about the shop, indicating sufficiently that it was not iron.

In Hinsdale, a very large quantity of the same ore is found on a hill one mile southeast of Hinsdale meeting house, and not far from the Ashuelot river. On the top of this hill the bed is sufficiently exposed, and is 7 feet thick and 55 feet in length, but extends under the soil to a still greater distance. It is included between strata of gneiss, runs nearly north and south, and dips to the east 84°. The surface of this mineral appears to have been acted upon by decomposing iron pyrites, and is very magnetic, there being several centres of attraction, or poles, along the face of the cliff, which reverse the compass needle on passing them. This led to the belief that the mineral was an iron ore, but it was evident that no such ore existed there, and the magnetism was probably due to the presence of minute particles of brown pyrites, and to the thin film of this mineral on the manganesian ores.

Descending this hill, we discovered several other beds of silicate of manganese alternating with the strata of gneiss. About half way down, a large granite vein is seen cutting through the gneiss, and presents a bold precipice at its termination.

The manganesian ores above mentioned have not yet been made use of in the arts, but since nature has produced them in such abundance, I cannot doubt that they will ultimately be found useful to man.

They may be used for making a very beautiful violet glass, having the rich color of amethyst. When ground fine, the mineral, if spread as a thin paste or wash on stone ware, will produce a very solid and unchangable glazing, or enamel, which will be of a black color, if of considerable thickness, and if thin will have an intense violet blue. It has not yet been used for this purpose, and I venture to recommend it to manufacturers of stone ware. It may be used in conjunction with the usual salt glazing, for the soda of the salt will combine with the silicic acid of the silicate of manganese, and form the glass or enamel glazing. Perhaps it may also be employed in enameling iron vessels in the same way that the porcelain lining is now prepared. It will then serve to protect the iron from the action of corrosive substances. If it should be found useful in the arts, New Hampshire and Maine can furnish many millions of tons of the ore. It is certainly worthy of attention.

At the base of Stony mountain, on its northwest side, are two small rounded hills, which an advocate for the glacial theory of drift would pronounce to be terminal *moraines* of a glacier, but if the ice rested on the side of this hill and projected itself over the plain where these hillocks are seen, the movement would have been nearly opposite to that of the ascertained direction of the drift movement. The grooves and scratches on the ledges at this place run N. 10° E., S. 10° W. They run along the hill side and are quite well marked.

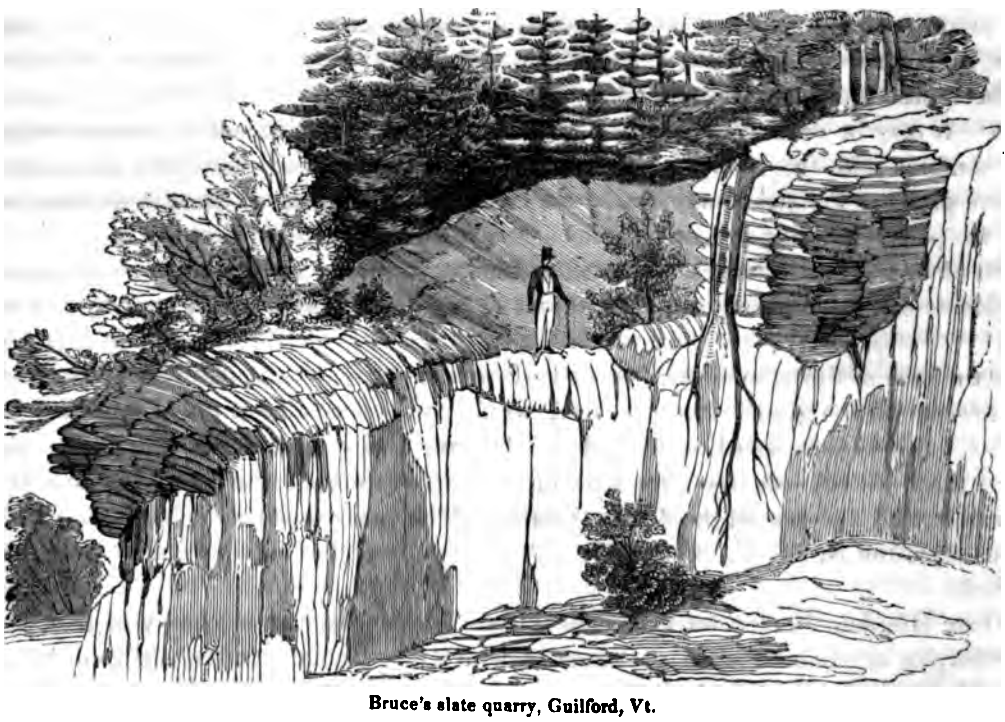
Where Hinsdale borders on Connecticut river, the rocks consist wholly of dark blue metamorphic or cambrian slate, the strata of which dip generally to the eastward, but are so nearly vertical that their inclination is sometimes inverted. Opposite to Brattleboro' they form high, steep and thickly wooded hills, adding not a little to the picturesque beau-

ty of that place. Many conjectures concerning the occurrence of veins of the precious metals among these hills have been indulged in by the inhabitants, but so far as I could discover, the supposed precious ores were nothing more than iron pyrites, a mineral which frequently misleads those who have not devoted some attention to the science of mineralogy.

Not far from the Connecticut river, on the Vermont side, good roofing slate abounds and has been extensively quarried in the town of Guilford. Those quarries were re-examined, and all the statistical information which could be obtained was recorded.

The quarry owned by Messrs. John and Thomas Bruce was first wrought thirty years ago, by the father of the present proprietors, and was formerly very profitable, 1000 squares, weighing 800 lbs. each, being sold annually. At present about 150 squares are disposed of per annum. The slates are trimmed at the quarry into sizes from nine to twenty-four inches square or oblong; a pile of from 30 to 32 of them measure a foot in thickness. It is worth $4 per square at the quarry, after the slates are properly trimmed with the nail holes punched in them. It is sent down the Connecticut river in boats to Hartford, at a cost of $1,25 per square freight, and sells in Hartford from $6 to $7 per square. Owing to the competition produced by the low price of Welch slates, the business at this place has been less profitable than formerly, and now but one man is employed in quarrying and trimming the slates.

The following wood cut represents the appearance of the Guilford slate quarry seen from near the base of the cliff in front. It was sketched at my request by Rev. Mr. Cranch.



Bruce's slate quarry, Guilford, Vt.

The old quarry, now neglected for a better one, presents some curious appearances which have attracted the attention of geologists, the strata having the appearance of being crushed by violence, insomuch that it has been supposed to have been the landing place of some ancient iceberg, the weight of which is supposed to have crushed the out-cropping edges of the strata. I am, however, disposed to regard the fractures as the result of the action of frost in modern times, while the high inclination and slight curvature of the strata are to be attributed to a movement at the period when the materials were comparatively soft and flexible. This would result from the crowding of the strata, by elevation of the neighboring primary rocks. Curvatures to a much greater extent were seen in the vicinity of Brattleboro', and they were shown to me by Mr. Bradley, who first observed them.

On examining the dip of the strata in the rear of this quarry, it was found that in the pasture they dip N. 98° W., and run N. 20° E., S. 20° W.; and in the orchard the dip is W. 35°, and course N. 30° E., S. 30° W. Immediately in the rear of the quarry the strata are contorted, and dip to the westward and run N. 15° E., S. 15° W.

The length of the broken or crushed strata in a north and south direction is 168 feet, and the breadth in an east and west direction is 139 feet.

A large proportion of the broken slate must have been removed in clearing the place of rubbish, during the operations of the quarrymen.

A short account of this locality is given in the first part of this report, page 55.

In Brattleboro' calcareous marl, made up of the remains of fresh water shells, such as the cyclas lymnea and planorbis, is found on the estate of Mr. Zenas Frost, and specimens of it were obtained for me by Mr. Bradley. This deposit was formed in such a manner as to indicate the former existence of a pond of fresh water at that place, which was subsequently drained and the surface covered with swamp muck, which is now two or three feet in thickness over the marl, the latter being three or four feet thick. It is carbonate of lime mixed with a little of the crenate, apocrenate and humate of lime, and will answer admirably as a fertilizer to soils wanting calcareous salts. By burning, it may be converted into good quicklime. (See description of the marl pond of Columbia, page 105 of this report.)

Blue limestone, sufficiently pure for agricultural purposes, is found in the immediate vicinity of Brattleboro'. The locality was visited in company with Mr. Bradley, and specimens obtained for chemical analysis. These localities are sufficiently near to New Hampshire to interest the people residing near the borders.

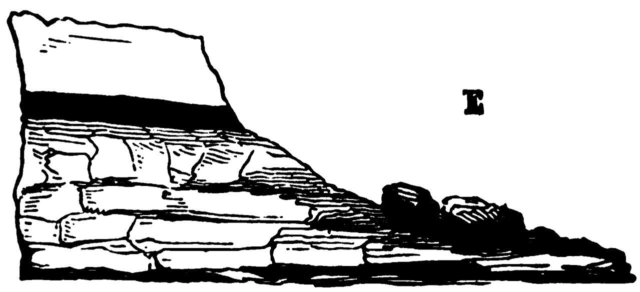
In Chesterfield, we heard of a supposed iron mine, half a mile from the Keene road and a mile and a half from the Factory village in Chesterfield. This locality was examined and proved to be nothing more than a bed of hornblende rock, included in gneiss, a few spangles of specular iron ore only being discovered, scattered sparingly in the rock. It is of no economical value.

Passing through Dublin, numerous drift scratches were noticed on the surface of the porphyritic granite, which extends from that town to Peterborough. They have a S. 17° E. course.

On the way from Deering to Weare, we examined a supposed silver mine on the land of Mr. John Leighton, a mile and a half northwest from the tavern, on the Deering road. It

proved to be only a locality of iron pyrites. A deep hole, now filled with rubbish, proved that those who had attempted to find a valuable mine there, had been disappointed.

In Dunbarton, a silver mine was talked of, and on searching for it, we discovered that an ore of arsenic had been mistaken for silver. This locality is situated near the house and on the estate of Mr. Stephen Wheeler, who kindly assisted in its exploration. The arsenic ore is included, as a bed, between the strata of mica slate resting directly on granite. It is from six to eight inches in thickness, and is very heavy and rich in arsenic. The bed dips with the strata to the south 80°, east 20°, and runs north and south. Large quantities of loose pieces of the ore may be easily obtained on the surface and in the soil.



The diagram above represents the situation of the arsenical pyrites, the black representing the vein.

This mine is a quarter of a mile northwest from Mr. Stephen Wheeler's house, on his estate adjoining Deacon Joel Wheeler's. The field where it occurs was, when we were there, cultivated for rye, but is very rough, broken and rocky.

Associated with the arsenical pyrites the green arseniate of iron is found, forming investing layers on the ore, and scorodite, or the yellow arseniate of iron, occurs in concretionary masses and thin crusts between the joints and in cavities.

A little argentiferous galena was also found in disseminated bunches and crystals.

Radiated black tourmaline exists in the mica slate, and quartz crystals are found in the vein and in the soil. Kaolin, or clay from decomposed granite, fills up many of the spaces between the rocks. From the frequent association of arsenical pyrites with tin ore, we were led to expect its occurrence at this place, and worked diligently in search for it, until driven from the field by a heavy and long continued thunder storm with violent rain. It may be worth while to search the rocks in this vicinity with care, to ascertain if oxide of tin occurs there.

Warner. The rocks in this town are gneiss and mica slate, the latter containing beds of talcose rock and limestone. The gneiss contains finely colored pyrope garnets, but it is very difficult to extract them whole. Accompanied by Mr. Levi Bartlett, we visited every locality of any interest in the town, and subsequently in company with Mr. Thompson and a number of other gentlemen, ascended the Kearsarge mountain, and measured its height and obtained specimens of the rocks and minerals.

Talcose rock, or soapstone, was discovered some time since on the estate of Mr. Charles Davis, 80 rods southeast from his saw mills, on the west side of the road near the house of

Micah Burbank. The bed is included between strata of mica slate, and runs N. 10° W., S. 10° E., and is twelve feet wide. It may be drained to the depth of 100 feet into the river 30 rods distant. The stone has been sawed at the mills, but no regular quarry has yet been opened; so that it is difficult to say what will be the character of the stone when fully exposed.

The blocks which had been got out, were rather hard to saw, on account of the occasional presence of particles of iron pyrites and mica. Some of them were quite free from those minerals. Mr. Davis has made some very handsome and serviceable sinks of it. I saw also at his mills a large block about to be sawed, which was four feet long, two and a half wide and two feet thick. A saw, when run two or three times through one of these blocks, is found to be so worn on the sides of the teeth as to bind in the stone. When dried slowly, the soapstone will withstand a high temperature without cracking, and is not liable to melt in the fire.

I consider it valuable to the people residing in the immediate vicinity, since it can be applied to many useful purposes; but it is not sufficiently soft.

The quarry, when properly opened and wrought, will furnish many good and sound blocks of soapstone.

The rocks on the estate of Mr. Levi Bartlett contain a sufficiency of carbonate of lime to cause free effervescence, when acids are poured upon them, but are not rich enough to burn into lime that will slake with water.

In the southeast corner of Warner, a bed of limestone was found included in compact mica slate. The bed is very irregular, not having any distinct walls of separation from the rocks including it. Much of the lime is combined with silica, forming white silicate of lime, which is mixed with the crystaline or granular carbonate in thin plates and scales. This combination proves that the rock, since the deposition of the materials forming the limestone, has been subjected to heat during the period of consolidation of the mica slate including the bed.

The thickness of the limestone is twelve feet, where it has been opened for the purpose of quarrying the rock for the manufacture of lime.

Although it is too much mixed with foreign matters to furnish lime for a distant market, still it is of value to the farmers in the immediate vicinity, since wood being very cheap, it may be converted into sufficiently good lime for agricultural use at a small expense. Wood is worth 17 cts. per cord, standing, and cut 8 feet in length, is worth 25 cts., or 75 cts. delivered at the kiln. The present price of lime in this town is $2.50; but it will probably be cheaper, since the completion of the Concord and Boston Railroad furnishes a cheaper mode of transportation.

Visiting a part of Warner, called Joppa, we examined some peat bogs and a supposed mine of iron ore in the southeast part of Warner, on the estate of Matthew B. Annis. This proved to be nothing more than a thin crust of peroxide of iron, derived from decomposing iron pyrites, and is worthless. It was said that horseshoes had been made of this ore, and the right of mining had been sold for $50.

The peat bog on this estate is valuable, and by proper drainage and cultivation, will

prove to be the best land on the farm. It is probable, owing to the abundance of pyrites in the surrounding rocks, that the peat will be found to be charged with sulphate of iron or copperas, which should be decomposed by mixing in freely lime or ashes, during the cultivation of the bog. On the estate of Mr. Gove, there is a peat bog of more than 20 acres, which may be reclaimed and will prove valuable. (See agricultural observations.)

Drift scratches are observed near this place, on the gneiss rocks, and have a course S. 10° and 15° E. Rounded masses of granite rest on the surface of the ledges. Having examined the agricultural improvements of Mr. Bartlett, an account of which will be consigned to another department of this report, we made an excursion to Kearsarge mountain in company with several gentlemen resident in Warner, (our party consisting of 26 persons,) and measured the height of the mountain and its latitude.

The Kearsarge mountain is a lofty and conspicuous elevation, situated on the gore now included in the town of Warner. It is composed of compact mica slate rocks, much corroded by decomposition, having a course S. 35° E., and deeply furrowed by drift striæ and deep and broad furrows, presenting the appearance of having been for a long period of time subjected to the action of water, and abrasion by moving masses of rocks, sand and gravel. The strata run N. 60° W., S. 60° E., and dip northwardly 80°. A few boulders of porphyritic granite were seen on the top and on the sides of the mountain, but no such rock exists there in place.

On the summit there is a deep bowl or trough-shaped cavity, the sides of which are worn smooth and scratched as above mentioned. Veins of a very deep colored rose quartz are abundant, and traverse the mica slate rock on the sides and near the summit of the mountain, but it was found impossible to obtain good specimens without blasting the rocks by gunpowder, those on the surface being rarely of good color, since it fades by the action of sunlight.

By barometrical observations, Kearsarge mountain is 2313 feet higher than the ground at Walker's tavern in Warner, or 3067 feet above the sea level.

By meridional observation of the sun's altitude, measured with a sextant and mercurial artificial horizon, its latitude is N. 43° 22′ 42″.

Kearsarge mountain is covered with forest trees around its sides, but its summit is naked rock. The ascent is rather difficult on account of the steepness of its sides, and the abundance of small trees and branches which obstruct the traveler, especially if ladened with philosophical instruments. The morning when we set out was fair, and promised a good opportunity for exploring the mountain, but in the afternoon a tremendous thunder storm, with a deluge of rain, fell upon us, and continuing through the night, prevented further observations. Descending the mountain, soaked with rain and chilled by the cold mountain air, we traversed numerous torrents of water that filled the channels, which were dry at the time we ascended the mountain, and reached the village of Warner excessively fatigued.

The Mink Hills were examined by Mr. Channing, who measured their height barometrically, and found the western hill to be 1380 feet above the ground at Walker's tavern, or 1954 feet above the sea. The sides of this hill having been in a great measure cleared of forest trees, rendered its ascent easy. The rocks are mostly porphyritic granite imbedded

in gneiss. On the surface of these rocks, at the summit and on the sides of the mountain, numerous well defined drift grooves and scratches were seen, and their course was S. 30° E.; this direction being uniform on both sides of the mountain.

A very large and deep peat bog, on the estate of Benjamin Harriman near the base of the hill, was examined. It comprises 22 acres, and is more than 25 feet deep, a pole having been thrust into it to that depth, without reaching solid bottom.

From the depth of two, three and four feet, beaver sticks have been dug out of this bog. They are marked with the beaver's teeth, where they have been gnawed off at both ends or denuded of their bark. One of these sticks was stated to have been of red oak and as large as a man's thigh. It was gnawed off neatly at both ends, after the usual manner executed by beavers. Those found at some depth are generally rotten, falling to pieces when dug out, but near the surface they are sound and well preserved.

This spot must have been an ancient beaver dam. It is requisite in order to effect thorough drainage of the bog, to blast away the rocks, in order to gain sufficient depth of channel to discharge the water.

Returning to Concord, an excursion was made to Canterbury, where some agricultural information was obtained, which will be reported in another part of this work. The Shaker Village is 440 feet higher than the ground at Concord State House, and the latitude of the place, by meridional altitude of the sun, is N. 43° 21′ 21″.

Sanbornton Bridge village, three and a half miles from Shaker village, was visited, and the rocks were searched for limestone, which had been supposed to exist there, but it proved to be felspar of a coarse granite vein which traverses the gneiss. Specimens of decomposed felspar containing garnets, were also shown me, under the impression that they were gypsum. No limestone occurs at this place. Gypsum belongs exclusively to a secondary formation, and of course none will ever be found in the primary districts of New Hampshire.

Franklin. On visiting this town, but little geological information was obtained, the the rocks being granite and gneiss, and containing but few and unimportant minerals. My attention was, therefore, directed to agricultural improvements, and the information obtained will be inserted in its proper place in this report. A peat bog belonging to Mr. C. Merrill, was visited. It comprises about 30 acres, and is two feet deep, with a hard clay pan beneath it. This bog has been reclaimed and has satisfactorily rewarded the owner.—Some specimens of the Bristol plumbago were handed to me by Mr. Nesmith. It was obtained from Mr. Dunbar's mine, which is not wrought at present. It is good plumbago, suitable for the manufacture of crucibles.

Andover. In this town mica slate rocks are prevalent, and have a course N. 40° E., S. 40° W., with a dip to the S. E. Plumbago occurs in this rock in irregular nodules mixed with fibrolite and garnets, but the quantity is too small to prove of economical value.

Wilmot. In this town we discovered a new locality of handsome beryls, which occur in the quartz and largely crystalized granite, near the meeting house and not far from Mr. Chapman's. Mica and very pure largely crystalized felspar are also abundant at the same

place. The best crystals of beryl are found in the veins of smoky quartz which traverse the granite. The felspar is suitable for porcelain making and for mineral teeth; a quantity of it was given to dentists in Boston, who have used it for this purpose and found it to be a good article. Crystals of mica, in a hexahedral form, are obtained six inches in diameter, but few large plates like those found in Alstead and Grafton, could be obtained.

Half a mile east of the meeting house, on a hill, some fine beryls were noticed, and one had been got out, which weighed thirty pounds.

SPRINGFIELD. In this town a quarry of mica has been wrought, on the land of Mr. Joseph Hills, and while blasting the rocks for it, large crystals of beryl were obtained. The crystals are very abundant, but are generally dull and opaque, having more the color of felspar than of beryl. A few fine transparent crystals have been obtained from the quartz veins. The crystals in possession of Mr. Hills were from six to eight inches in diameter, and from a foot to twenty inches in length. Handsome druses and crystals of quartz were also found at the same place. The rocks are mica slate and granite, the latter forming large veins in the former. The great vein containing beryls, runs E. by N., W. by S., while the mica slate has a N. N. W., S. S. E. course, and dips to the N. E. 80°. Black tourmaline in large crystals is abundant in the granite. Plates of mica, six by eight inches, are obtained at the quarry in abundance.

Garnets in the form of perfect trapezohedra are very abundant, and are readily obtained entire, by breaking up the disintegrated mica slate with the hands.

Drift scratches were seen on the ledges near the poor farm, on porphyritic granite, and have a S. 5° E. course. The latitude of Springfield, at Durgin's tavern, was ascertained to be N. 43° 29′ 25″—height above the sea 1355 feet.

ENFIELD. In this town we examined the farms belonging to the Shakers, and several localities of minerals which occur in the vicinity.

There are small veins and nodules of magnetic iron ore pyrites on Lowe's hill, in the east part of the town.

Copper pyrites, occuring in small veins, has been found a mile and a half from Mr. Steven's house, on Howe's hill. Specimens of it were given me for examination, but the locality was not deemed of importance. Excursions were made to Canaan and Grafton, where a number of interesting minerals were obtained.

At Mr. James Bucklin's, in Grafton, a vein of copper and brown iron pyrites was noticed on the road from Springfield to Enfield, near the base of Pinnacle hill. This vein proved to be a continuation of ore subsequently visited on Richardson's hill in Canaan. It is narrow, but sufficiently rich in copper to reduce advantageously, if enough of the ore could be procured. The rocks are hard, and mining would be expensive. The brown pyrites at this place, as on Richardson's hill, contains a very minute quantity of native gold, but not enough to repay the expense of extracting it. Bog iron ore and bog manganese, suitable for paint, are found in the low lands at the same place. Hæmatite iron ore was also found in small quantities on Pinnacle hill, associated with handsome crystals of quartz.

CANAAN. After visiting the Shakers' land in this town, we examined the mine on Richardson's hill, near the house of Mr. Kimball. This mine was owned by a small joint stock company, the shares being 50, at $2 each. An attempt was made to ascertain the value of the locality by mining, and the whole capital was expended without coming at any satisfactory results. Almost a ton of the ore, in possession of Mr. Stevens, was examined, and found to consist of a mixture of yellow copper and iron pyrites, with brown iron pyrites, which, on analysis, yielded a minute quantity of gold. Most of the pyrites had undergone spontaneous decomposition by the influence of air and water, and was converted into copperas or sulphate of iron.

The veins of these ores, at the mine above mentioned, are from 6 to 10 inches wide, and are mixed with quartz and included in gneiss rocks. They run N. 5° W., S. 5° E., and dip E. 80°. The gneiss strata have a course, N. 35° E., S. 35° W.

Associated with the pyrites, masses of carbonate of iron in crystaline folia of a deep brown red color, are found, and a little sulphuret of molybdena was also observed.

The mine has been opened for a distance of 30 feet in length and 20 feet in depth.

The drainage is free, so that no pumps were required. The ore was traced 200 yards north of this opening, and Mr. Kimball says he has observed it a mile to the north. From its direction and identity of associated minerals, I have no doubt of its extending to the one noticed at Pinnacle hill, near Mr. Bucklin's in Grafton.

The rocks in Grafton, Danbury and Orange were mostly a coarse granite, containing largely crystalized felspar and mica, with veins of smoky and limpid quartz.

In the granite and quartz are found numerous brilliant and often finely colored crystals of beryl, varying from the transparent and colorless to the finest hues of aqua marine and deep greenish blue. Some of the smaller crystals from the quartz veins, and especially those dug up from the soil, formed of disintegrated granite, are remarkably fine, and are suitable for jewelry. The large crystals are, as usual, defective, having numerous cracks or other imperfections, which render them interesting only as cabinet specimens. The various localities of this beautiful mineral had been diligently sought out by Mr. Abraham Cassel, an old man resident at Grafton Centre, who has devoted much time and labor in collecting them for sale. Selecting him for our guide, and employing him to blast the rocks, the localities were soon examined and specimens obtained in abundance.

The best specimens were obtained at the following places:

A mile west of Grafton Centre, on the land of Mr. Lovell Kilton, where the finest crystals are obtained from the quartz veins and from the soil around the rocks; in Danbury, on the land of Mr. Barney, not far from the Orange town line, where the deep blue beryls are found in the granite and quartz veins, traversing it. A few have also been found near that place on Horse hill, not far from the barn of Mr. Simeon Hale. Crystals of a "fine water" are more frequently obtained from the soil than from the rocks, the organic acids of the soil having, during the time that they have been buried in it, extracted the accidental impurities which so frequently injure the transparency of those included in the rocks. The small crystals are the best for ornaments, and when properly cut by the lapidary, are difficult to distinguish from diamonds, so brilliant is their lustre. Those who feel desirous of wearing ornaments made from native minerals, will do well to

select them from the rocks and soil of Grafton and Danbury. To the mineralogist, the perfect terminations of some of these crystals will prove most interesting, many of them having twelve facets on the terminal extremities of the six sided prism. (See figures and description of this mineral in Philip's Mineralogy, Algers Ed., p. 162, and J. D. Dana's Mineralogy, p. 391.)

Among the chemical analyses in this report will be seen one of a beryl from New Hampshire.

A few specimens of garnet, of good color, but difficult to extract whole, from their intimate connection with the rocks, also occur in Grafton. Iron pyrites and a little magnetic iron ore were also found. Felspar is abundant and suitable for porcelain and for making mineral teeth. Mica occurs in large plates, as formerly noticed in the description of the Glass hill. Infusorial silicia is found in the ponds and bogs in Orange and Grafton, and has recently been obtained for polishing powder.

Orange, or Cardigan mountain, was said to abound in minerals, but on ascending it nothing was discovered but a uniform mass of porphyrytic granite, which composes the entire mountain.

Its height was measured barometrically, and found to be 1720 feet above Mr. Barney's house, and 1303 feet above Mr. Joseph Kinney's.

Returning to Concord, excursions were next made on the eastern side of the Merrimack, passing through Canterbury to Gilmanton, where examinations of the different localities deemed interesting, were made with the assistance of Mr. Tenney, the preceptor of the Academy.

Gilmanton Corner. Porcupine hill was visited and examined. It is a remarkable abrupt precipice of granite, gneiss and mica slate rocks, which form by their overhanging strata and deep ravines, a picturesque and favorite resort, much frequented by the pupils of the Academy. Below this steep precipice is a deep and shady dell, thickly clad with dark evergreen foliage of forest trees, while the rocks are festooned by a profusion of curious and beautiful lichens or masses, which cling to their moist and cool surface. It will prove a more interesting spot to the botanist than to the mineralogist, since the minerals are few and of no great beauty, while the wild plants are most abundant.

Among the loose rocks mingled with the drifted soil of Gilmanton and scattered over the surface of the ledges, Mr. Tenney has found a number of minerals, which serve in part to form a collection for the instruction of his pupils. On Peaked hill he found loose masses of red porphyry, although no ledge or vein of that rock occurs in the place or near it. Black tourmaline is also abundant in loose rocks. Between Gilmanton and Canterbury, near a mill, two trap dykes cross the gneiss in the road way, and run N. 30° E., S. 30° W. The including strata are deeply stained by decomposition of iron pyrites.

Bog iron ore was formerly obtained from Lougeetown or Suncook pond, near the old Iron Works village.

From Gilmanton we went to Gilford and Centre Harbor, examining the supposed limestone at Dr. Perley's and at Mr. Pickering's. In both these places the limestone proved to be calciferous trap dykes, containing a sufficiency of carbonate of lime to effervesce with acids, but too poor for making lime.

The dyke at Dr. Perley's runs N. 75° W., S. 75° E., while that at Mr. Pickering's runs N. 10° W., S. 10° E. At the latter place there are large veins of white quartz containing crystals. These dykes and veins are in porphyritic granite. On the surface of this rock numerous well defined drift scratches are seen, having a course to the S. 12° E. Boulders of basalt with striæ on their surfaces also abound in the soil, and are quite distinct from any rocks found there in place, but identical with those found far to the northwest.

On reaching Centre Harbor, an excursion was made to Long island for the sake of agricultural information, and to obtain specimens of soil for analysis, where the farm of Mr. Boody attracted particular attention, several of those on the other parts of the island having been previously examined. (See agricultural remarks.)

Sandwich. The mountains of this town were examined, and the height of the most important one was measured barometrically, and by means of the sextant and artificial mercurial horizon.

Taking up a temporary residence with Mr. Neal McCrillis, excursions were made to the mountains for the purpose above mentioned.

White Face mountain is one of the most remarkable of the Sandwich group. It is very abrupt, and its summit is a naked rock, while its sides have been deeply scored by immense land falls or slides, which have denuded its rocky surface, and formed the beds of mountain torrents. The principal ravine is the most convenient route to the summit of this mountain. It is a gorge, from 30 to 50 feet deep, with abrupt precipitous sides of rocky soil, while the bottom is a confused heap of rounded and angular blocks of granite, sienite, quartz, felspar and trap rocks, which were hurled down the declivity by the great slide, which took place here many years ago.

Over this rough bottom rushes a small mountain brook, which, in the freshets of spring, is a roaring torrent. At the time of our visit it was easy to wade up this brook nearly to its sources, where the ravine was left, and a short struggle through the forest brought us to the bare and rough rocks, which extend to the summit.

This mountain is composed of a very compact sienite, a rock consisting of the minerals felspar and hornblende, with a little quartz. Its sides are of porphyritic granite. No minerals of interest were discovered, but its height and latitude were measured. From Mr. McCrillis' house this mountain is 2971 feet high, according to barometrical measurement, and 2970 feet high, as measured trigonometrically by angles taken with the sextant and logarithmic calculation. It is 4178 feet above the sea level. Its latitude, by meridional observation of the sun, is N. 44° 1′ 9″.

From Mr. McCrillis the following history of the slide, which had taken place from this mountain and covered so large a portion of the meadows below, was obtained.

The season had been very dry and the soil was spongy and loose, when heavy rains set in and continued for a number of days. The slide took place in October, 1820, with prodigious violence and great noise. The obstruction of the mountain stream made a dam and flowed its banks so as to form a pond, which bursting its barrier, rushed down the mountain's sides, sweeping in its impetuous course rocks and trees in promiscuous confusion, and cutting a deep ravine in the side of the mountain several miles in extent. In its course the slide struck against a barn, but did no harm to the animals within, they escaping from

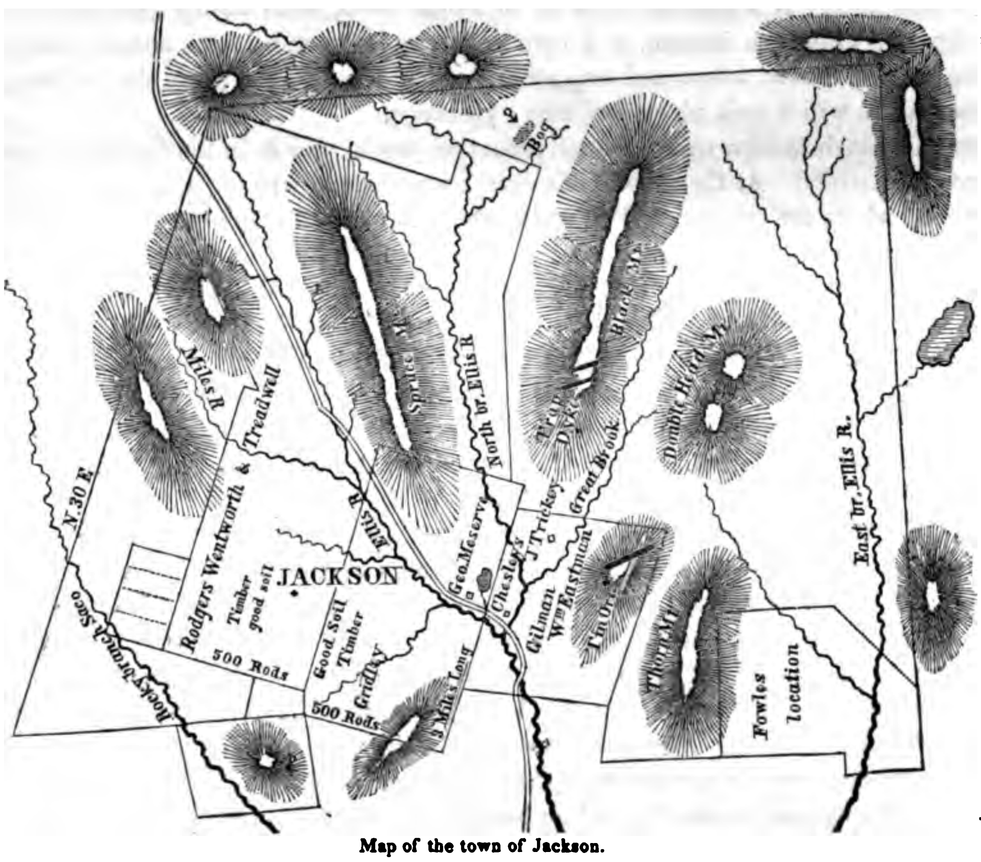
the door as it burst open. The fine alluvion brought down by the torrent, covered an extensive meadow at its base, and rendered it more fertile for grass, white clover springing up where only coarse wild grasses grew before. Some parts of this meadow were covered with a fine sediment four or five feet in depth. At the upper part, where the coarse gravel covers it, there is but little vegetation.

We heard of a lead mine on the other side of this mountain group, but had not time to visit it during this excursion. Since then a box of specimens has been obtained from the proprietors, and on examination they evidently indicated that there was no regular vein of the ore, for it was found in small scattered particles in quartz, the largest being of the size of a filbert. The ore is rich in lead and contains about three lbs. of silver to the ton of ore, but is in too small quantity to prove of value.

Leaving Sandwich, and passing through Eaton to Bartlett, we ascended Pequaquet mountain, and measured its height barometrically, and its latitude by means of a meridional altitude of the sun, taken with a sextant and mercurial horizon. The height of the summit of the mountain was found to be 2680 feet above the ground at Pendexter's hotel, in Bartlett, and 3367 feet above the sea level. Its latitude is N. 44° 7′ 15″.

Chocorua peak, observed over a spirit level, was nearly of the same height with Pequaquet mountain. Specimens of the rocks having drift scratches on the surface, were obtained on the mountain side, and their course was observed on the ledges to be S. 35° E.

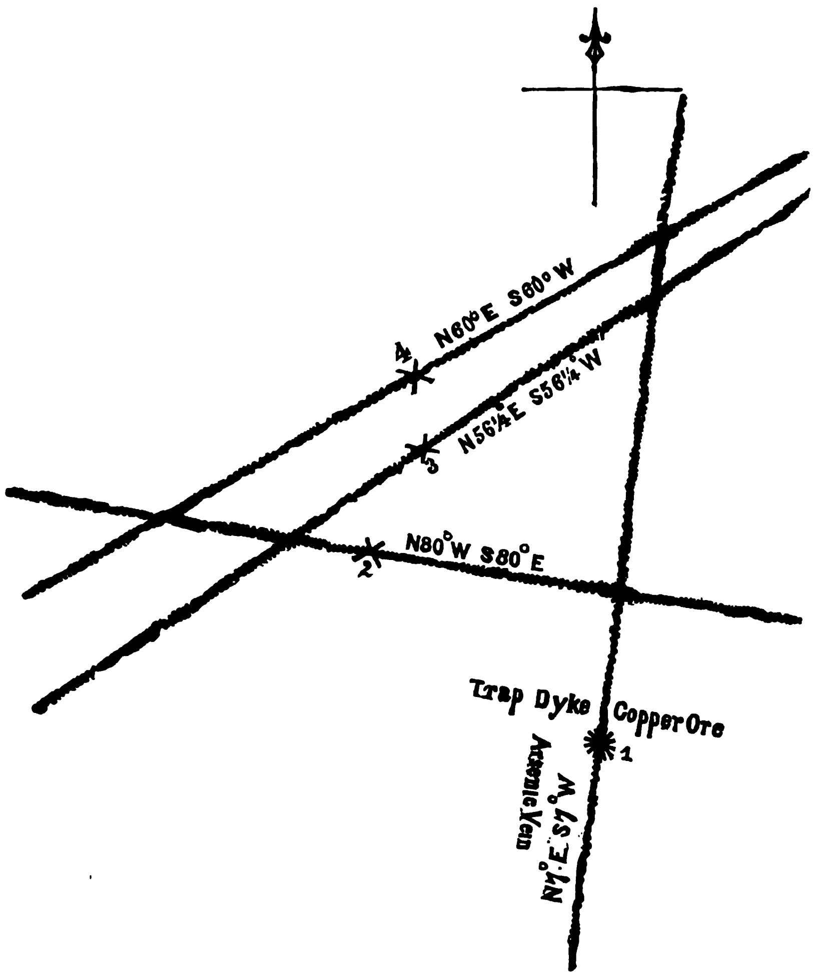
JACKSON.



Map of the town of Jackson.

Having obtained the loan of the plan of a new survey of the town of Jackson, through the politeness of Geo. Meserve, Esq., I made a copy of it, and then filled in the topography of the township, putting down all the localities of interest, and since the State map does not give the topography of the place, which is but little known, I have presented a wood cut engraving, on which all the details are laid down.

Learning that Mr. Eastman had found a new vein of tin ore, near the locality where I discovered it during the first and second year of the survey, I revisited the place and made a survey of the veins, by taking observations on their course and their angular, and measured distances from the first vein discovered, and have since drawn the following plan, which represents their situation, and will serve to guide the miners in their operations.



Scale, 100 feet to the inch.

Plan of the tin veins on Eastman's hill, in the town of Jackson.

Each vein is marked with numbers, indicating the order of their discovery, and the marks * and × indicate the places where we opened the veins. The bearings of each

opening was taken from 1*, and the distance to it measured; then the course of each vein was taken with the compass, and the plan was laid down, as usual, by means of a protractor and scale.

The best places for mining are evidently at the crossings of the veins, where the ore is in greater abundance, and two veins may be wrought in the same opening.

From the first opening in the vein running N. 7° E., No. 2 is distant 157 feet; No. 3, 182 feet; No. 4, 216 feet. There is a very small vein, not put down on the plan, as its course was so irregular that it could not be correctly ascertained.

No 1, is a vein of the crystalized and compact tin ore, associated with copper pyrites and arsenical pyrites. It was first discovered by me on the 28th of September, 1840, while searching for crystals of the arsenical ore.

No. 2, is a highly crystaline ore, mingled with arsenical pyrites, and is contained in granite. It was first noticed by Mr. Forest Shepard, who visited the locality in 1841.

No. 3, was discovered by me in the same year, and is compact tin ore in mica slate.

No. 4, was discovered in the same year by Mr. Eastman.

A trap dyke cuts off the vein No. 1, and the accompanying arsenical pyrites vein, and the lode changes at the point of contact and near it into copper pyrites, purple copper, and small radiating filaments of native copper are found in the trap rock. The cross veins are all, excepting the crystalized ore in the granite vein, the compact oxide of tin or tin stone, which, although in narrow veins, is easier to work, since the ore may be readily picked, and is extremely rich and heavy, yielding 73 per cent. of tin by assay. The crystalized ore is more disseminated in the rock and vein stone, and yields from 30 to 40 per cent. of metal by the usual processes of assaying. The rock near the veins yields from 2 to 10 per cent. of tin, the ore being in it in very small particles, separable by stamping and washing.

Having taught many persons in Jackson how to distinguish tin ores, I have no doubt that they will discover other localities in that vicinity. It is likely that small veins of oxide of tin have escaped notice, on account of the resemblance which it bears to some ores of iron, and this may account for the fact that not a single vein had been discovered in the United States, anterior to those which I have described as occurring in this town.

I gave a number of small crystals of the tin ore of Jackson to Mr. J. E. Teschemacher, and requested him to examine their forms in comparison with those of other localities, and he has favored me with the following communication:

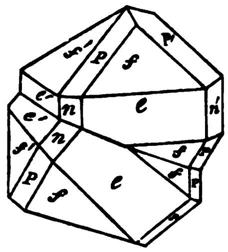
Boston, Dec. 4, 1840.

Dear Sir—Below you will find a drawing, much enlarged, of the form of most of the crystals in the specimens of tin ore discovered by you in New Hampshire, which I have examined. The planes are not sufficiently free from striæ to permit the use of the reflecting goniometer in ascertaining the angles; the measurements are therefore those of Phillips, of the accuracy of which I entertain no doubt. The form is that of a macle of the square prism, with a pyramidal summit, arising from modifications of an obtuse octahedron with a square base, the primary form of tin oxide; P. and P. the only remains of this primary. The figure represents a macle of only two crystals; the originals are composed of several united in the same way. This is, I believe, the most common of the crystaline forms in the tin deposits of other countries, and appears to me a reason for supposing the

deposit in New Hampshire to be large, which I should have doubted, had the crystaline forms been those of rare occurrence elsewhere.

Yours, sincerely, J. E. TESCHEMACHER.

Dr. C. T. JACKSON, Boston.



P on *f* 150d. 45m. *f* on *e* 133d. 32m. *n* on *e* 135d. Planes *e* usually striated.

Large patches of a peculiar porphyritic trap rock are abundantly scattered in the granite veins, which occur in the mica slate of this hill. This trap rock is much more ancient than the principal dyke which traverses the veins, and was brought up in fragments by the granite at the time it was elevated through the mica slate rocks. It is filled with crystals of a glassy and almost transparent felspar, and crystals of dark brown hornblende. The granite runs nearly parallel with the general course of the mica slate strata, having the appearance of alternating beds. The tin ores were deposited in the fissures in the granite and mica slate, at the same epoch and subsequent to the eruption of the granite, for the veins traverse both rocks, and are evidently of the same age. They were deposited anterior to the eruption of the crossing dyke of trap, for that dyke cuts off the veins.

The widest portion of vein No. 1, was eight inches, and that mass yielded 30 per cent. of tin. It was found to diminish in width to the south, and was cut off by the trap dyke at the north. No. 2, is half an inch wide. No. 3, from half to three quarters of an inch wide. No. 4, from a half to an inch and a quarter wide. Associated with the tin ores the following minerals were found:

Veins of arsenical pyrites, very compact and rich in arsenic; arseniate of iron, both the green and yellow varieties; copper pyrites, in small veins and disseminated masses; black sulphuret of copper, (rare); carbonate of copper, investing the surface of the copper pyrites and the including rock; native copper; tungstate of manganese and iron, (rare); phosphate of iron; fluor-spar, both the white and purple varieties, in the north and south vein; sulphuret of molybdena, (rare,) and black tourmaline, principally in the granite veins; quartz crystals in small veins, and druses in the cavities. All the veins of tin ore have evidently been deposited on the sides of crevices in the granite and mica slate, and have filled the space from the sides to the centre, where there is a line of crystalization or a thin layer of quartz, separating the vein into two equal parts. This proves the ore to have been raised by sublimation into the crevices where it is now found, and we know of no other chemical method of imitating this, excepting by the agency of fluorine, in accordance with the interesting theory of M. Daubree, published in the French *Annales des Mines, Tome XX., Livr. IV.*, 1841. (See the annexed translation.)

He regards tin ores as having been formed by the sublimation of the fluoride of tin, which underwent decomposition by the agency of water and the earthy and metallic bases contained in the rocks, the oxide of tin being deposited as fast as the decomposition proceeded. The fluoride is the only known volatile combination of tin, and this theory appears to be plausible, and is supported by the fact that tin ores in all parts of the world are accompanied with fluoriferous minerals, such as fluoride of calcium, or fluor-spar, and mica, charged with fluorine. He regards the tourmaline as a necessary concomitant mineral with tin ores, since the boron contained in it, was sublimed in combination with fluorine. The phosphates he supposes to have a similar origin. Topaz and picnite are commonly found in the European tin mines, and they are eminently fluoriferous. Quartz is also supposed to have been sublimed in the state of fluo-silicic acid gas, and to have been precipitated as silex in the veins.

Arsenic is also a volatile metal, and even copper may be converted into vapor at a high temperature, and they always accompany tin ores.

The occurrence of fluor-spar, mica and the volatile metals in the Jackson tin veins, seems to lend support to M. Daubree's theory, while the concomitant minerals all indicate that the tin ores, at that locality, were formed under precisely the same circumstances as those in Saxony, Bohemia and Cornwall, a fact not to be overlooked in future explorations, and one which leads to the belief that the locality may prove worthy of a thorough examination by mining.

New minerals, not found as yet, may be confidently expected, when openings of sufficient extent are made amid the veins. Topaz has not yet been found there, but I have no doubt, from its constant occurrence in all the European tin regions, that it will be discovered.

Although our excavations have not yet exceeded three feet in depth, which is but a mere surface scratch, when compared with the works in Europe, still much has been discovered, and I have been able to prove that miners can now earn good wages at this locality; for having employed two men for two days in excavating and extracting the ore from vein No. 4, I found that the ore they raised, weighed 100 pounds, and it yielded, on average samples, from 35 to 40 per cent. of fine tin, worth 22 cents a pound.

Then each man raised 25 pounds of ore per day, and this yielding, say 40 per cent., will give 10 pounds of the metal, worth $2.20, and allowing one third as the expense of reduction, there would remain $1.47 as the net proceeds of the labor of one miner.

Although the men I employed were strong and active, still, without practice, they cannot be supposed to possess so much skill as one who has spent a large portion of his life in mining, and, therefore, I suppose that a skillful miner would be able to raise a still larger amount of ore per day. About one third of the ore blasted out was lost, being scattered by the explosion of gunpowder, its density causing it to fly to a great distance in the air, so that a part of it was lost in small fragments in the neighbouring woods. The amount of this loss was ascertained by measuring the vein, and calculating its contents and weight by specific gravity.

In underground mines no ore is lost by blasting, since it is retained by the walls of the mine, and falls immediately to the ground.

From the foregoing considerations, it is evidently worth while to pursue the exploration of the Jackson tin veins, and if it is done in a proper manner, by skillful miners, the value of the locality may be soon ascertained.

Its situation is as favorable as can be desired for the opening of a mine, for drainage is readily obtained, and the hill side affords a good site for the opening of as many galleries or levels as may be deemed requisite. One drift may be driven into the hill beneath the one above it, there being room enough for many such openings. The levels, of course, will follow the direction of the veins, and a perpendicular shaft should be made amid the crossing veins and carried down to the levels, thus extracting the ore, while ample drainage and ventilation are secured.

Underground mining is very little understood in this country, and too frequently we see mines wrought like open quarries, the water and snow penetrating into them so as to render the work uncomfortable both in winter and summer. A deep, well ventilated and drained mine is not so unpleasant a work shop as many are led to suppose.

If thirty feet deep, the temperature is that of the mean temperature of the climate, and is cool in summer and warm in winter; if deeper, the temperature of the mine is one degree warmer for every sixty feet of descent into the earth; so that most laborers would prefer working in a good mine to laboring above ground in mid-winter. Miners, like sailors, are very much attached to their profession, and affect a sort of heroism amid the peculiar dangers of their avocation.

With regard to the width of the veins, I would observe that tin ores never occur in wide veins, and it is only by working as many contiguous ones as possible in a mine, that a large supply is obtained. There are wider veins in most of the mines wrought in Europe, but there are none where the ore is richer than that found in Jackson.

Description and theory of Tin Veins, by M. Daubree. Ingenieur des Mines.

The following extract, which I translate and condense from M. Daubree's memoir on the tin mines of Europe, may serve to compare with those of Jackson, so as to form an estimate of the chances of success in mining operations, while at the same time an idea may be obtained of the nature of minerals that will be found associated with the ores.

" ZINNWALD. The country around these mines is quartziferous porphyry, through which rises a flat dome-shaped mass of fine grained granite, (*greisengranite*) which is partially decomposed into kaolin and lithomage. *Halomiete*, composed of quartz and mica, is the principal rock in Zinnwald. The tin ore veins are nearly vertical, and consist of a mixture of quartz, mica and oxide of tin. Each vein is divided in the middle, where there are crystals of oxide of tin. The width of the veins is from one centimetre, (4-10ths of an inch,) to 1 metre, 30 centimetres, (=4 feet nearly.) There are thirty veins, only nine of which are sufficiently rich to work. They are from 4 to 12 metres asunder, (13 to 39 1-2 feet.) They traverse alike the granite and porphyry.

The associated minerals are blue and white fluor-spar, yellow topaz, picnite, lithomage, (clay,) steatite, black tourmaline,* felspar,* sulphate of barytes,* and carbonate of lime,*

* Rare.

wolfram, (tungstate of manganese and iron,) very abundant in large crystals, tungstate of lime, arsenical pyrites, copper pyrites, grey copper ore, carbonate of copper in thin crusts, a little galena with phosphate and carbonate of lead, carbonate of iron, and a little uranium ore.

In Altenberg, three-quarters of a league from this locality, the rocks are gneiss, porphyry, sienitic porphyry, granite and basalt. The tin region is 440 metres* long, by 300 metres wide, (1443 feet by 984 feet.) There are numerous cross veins, mostly in porphyry, and from 30 centimetres, (1 foot nearly,) to 1 metre wide, (3 feet nearly.) The east and west veins are the richest, and the ore is in disseminated crystals. On stamping and washing 317 kilogrammes* of the ore, it yielded 1 *kilo.* 90 of washed ore, which yielded 1 kilogramme of tin. The ore from the small veins yielded in the same weight, 198 *kilo.* washed ore. From this it will be seen that the narrow veins are by far the richest in metal, the large ones consisting mostly of rock or vein stone.

In Auersberg, the tin veins are from 0.*m* 50 to 1*m* 60 in width, and occur in broken granite and a metamorphic slate rock, which passes into mica slate.

The tin ores of Erenfriedsdorf and Marienberg are in gneiss. The tin veins in Cornwall, England, are rarely more than 8 or 10 centimetres wide, and are from 1 metre to 1*m* 80 apart. The associated minerals are topaz, mica, apatite, (phos. lime,) wolfram, beryl and red silver ore.

The tin floor of St. Just, is 0*m*.50 thick, and associated with the ore are found crystals of quartz, axinite and tourmaline. The rocks are mostly the altered slates, called by the miners killas.

In France, tin is a rare ore, small veins only being found in Vaury and Puy les Vignes, in Haute Vienne. They occur in granite, with quartz, and are from one to two decimetres wide. The associated minerals are wolfram, sul. molybdena, arseniate of iron, copper pyrites, oxide and arseniate of copper, native copper, arsenical pyrites, lithomage and a little fluor-spar.

Tin veins are found only near the point of contact of two different kinds of rocks, and never more than 500 metres, (1640 feet,) from their junction."

Origin of Tin Veins. The veins are certainly fissures in the rocks, which have been filled after their consolidation. The attachment of the vein to the walls of the fissure, does not prove them to have been contemporaneous with the formation of the rock.

The veins cut through alike the veins of porphyry, granite and the slaty rocks.

They could not have been formed by contemporaneous seggregation, as is proved by their traversing different rocks.

Fluorine appears to have played an important part in the formation of tin veins.

Fluoride of tin is a combination, stable at all temperatures, and is very volatile.

Hence it may have been raised in vapor, from the fluoride; tungsten and molybdena may have been formed in the same manner.

Boron having a great affinity for fluorine, and forming with it a compound, which is not decomposable by heat, and is volatile, may be supposed to have been raised as a fluoride.

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* A metre is equal to 3.281 feet English, and a kilogramme is equal to 2.205 lbs. avoirdupois, English.

Silex may have been brought up as fluo-silicic acid gas, but part of the silex may have been derived from pre-existing silicates. Phosphorus often accompanies the fluorides.

The elaboration of these matters, subsequent to their sublimation, is not easily understood.

The proportion of fluorine in mica is sufficient to account for the production of the deposits of oxide of tin.

Steam of water, probably, acted as an agent in effecting the decomposition of the sublimed fluorides."

The localities I have described in Jackson, in all essential particulars, support the views of M. Daubree. Fluor-spar, however, occurs in only one vein; but mica, containing an abundance of fluorine, is the immediate wall of all of them. The fluor-spar is most abundant in the crystalized, or north and south vein, and is abundant along its course for a quarter of a mile to the south.

Iron ore on Thorn Mountain.

On Thorn mountain, in the town of Jackson, occur several veins of magnetic iron ore, which are contained in a kind of granite consisting of felspar and quartz without any mica, being, so far as respects its mineralogical composition, a porphyry, but not marked by squares of felspar, like a true porphyritic rock.

The iron ore is found near the top of the mountain, and on its western side. The veins are from a few inches to two and a half feet wide, and run N. 25° E., S. 25° W., traversing the mountain and widening as it descends, as may be seen along the slope of the mountain.

On the western side of the mountain the iron ore vein runs N. 55° W., S. 55° E., and widens, as it descends, from two inches to one foot.

A dyke of basalt cuts through the top of the mountain, and runs W. N. W., S. S. E. Porphyritic trap rock, like that of Eastman's hill, is observed included in the granite.

The iron ores above noticed, are heavy and compact magnetic oxides of iron, and will be valuable as a contribution to the ores of Bald Face mountain, when those great veins are wrought for iron; since it is an advantage to mix several varieties of ore, this mixture serving to render the slag more fusible.

The quantity of iron ore on Thorn mountain is not sufficiently great to supply a large blast furnace, but there is enough for a forge suitable for the making of bar iron.

From the summit of Thorn mountain a good view may be obtained of Pequaquet mountain, which bears S. E., and of Double Head mountain on the N. E. Bald Face mountain bears W. by S.

Specimens of the ores of iron were blasted out by gunpowder and taken for examination. (See analysis.)

Leaving Jackson, we rode to Mr. Abel Crawford's, and ascended with him to the summit of a mountain near his dwelling, which bears his name, our object being to measure its height, and to see some veins of iron ore which had been noticed by Mr. Beamis of Boston. By barometrical measurement, this mountain is 2085 feet high, from the ground

at A. Crawford's, and by measurement with a sextant and mercurial horizon, it is 2079 $\frac{12}{100}$ feet—diff. 5 $\frac{88}{100}$ feet. A straight line from Crawford's to the summit of this mountain, would be 8,515.65 feet in length.

The veins of iron ore on Mount Crawford are too small to prove of any value, the widest portions not surpassing an inch in thickness. A few quartz crystals are found in the granite, which forms the entire mass of the mountain.

Near Mr. Crawford's, a vein of quartz, containing crystals of fluor-spar of an apple green color, and crystalized in its primary form, attracts the attention of collectors of minerals. A few quartz crystals in the form of the six-sided prism, also occur at the same place.

The Crawfords have, since we ascended Mount Washington, found a new locality of black tourmaline, which has furnished some large and handsomely terminated crystals, specimens of which were shown me at that place. It is found in large masses of milk quartz, near the route to the summit of the mountain. The season being far advanced, and the top of the mountain being covered with snow, it was not re-examined. It would be necessary to encamp there and make extensive excursions, to discover any thing new; for the usual route pursued by travelers has been very thoroughly searched, and with but very little success. On the lower mountains, or spurs, more minerals will probably be discovered, since among them most of the ores, which have been found among the White Mountains, were obtained.

On reaching Mr. Fabyan's hotel, I was requested to measure the height and distance of Mount Washington from that place; and having a good opportunity of obtaining a horizontal base on the meadow near the house, the work was soon accomplished.

The base line, measured twice with a chain, was 142.33 rods in length. From the extremities of this line the angles were taken by means of a sextant and mercurial horizon, and the distance and height calculated, corrections being made for refraction of light and curvature of the earth, as usual. The distance in a straight line from Fabyan's to the summit of Mount Washington, is 2,297.1 rods, or nearly 7½ miles, and the height of the summit, as seen from that place, is 4,374.9 feet. The season was too far advanced for repetition of the barometrical measurement of Mount Washington, which was obtained during the first year of the survey with sufficient exactness, and found to be between 6,226 and 6,228 feet above high water mark in Portsmouth. (See first annual report.)

From the White Mountains we rode to Littleton, and after spending a day there, continued our journey to Lancaster, where some new researches for limestone were made, and the deposit of bog iron ore previously noticed on the land of Col. White, by my assistants, was examined, and specimens taken for analysis.

The iron ore is in heavy lumps, and in the form of a hard pan, in the meadow, not far from the road side, and is more than a foot thick, and very good. It was sold to Mr. Huxham Paddock of St. Johnsbury, Vermont, who paid one dollar per square rod for the right, and removed it, restoring the soil after removal of the mineral. The ore was carried to the St. Johnsbury furnace and converted into iron, being used to mix with the more refractory ores of Troy, Vt., and Piermont, N. H.

Learning from Mr. Wells that limestone was supposed to exist on his land, I went with him to examine it. The locality is four miles east from his house. On examination, the

rock proved to be an epidotic sienite rock mixed intimately with carbonate of lime, and containing small veins of granular limestone. It effervesces freely with acids, but is too poor in lime to serve as a limestone, and is liable to melt in calcination. The soil is very highly charged with lime from the disintegration of this rock, and is very fertile, bearing heavy crops of wheat. This rock is very interesting to those, who wish to investigate the origin of minerals by metamorphosis of their ingredients, for it is evident that the lime has played a conspicuous part in the changes which it has undergone, a portion of it entering into the composition of the minerals. The occurrence of epidote stamps the rock as decidedly a product of igneous alteration, it being a most frequent product of metamorphic action by heat. A little copper ore was found scattered through the rock, in the state of copper pyrites and crusts of green carbonate of copper.

In Lunenburg, Vt., I visited a tract of land belonging to Col. White, where a blue and grey limestone is found in abundance, but is not sufficiently rich to make good lime, although it may serve a useful purpose in agriculture. It contains nearly 50 per cent. of carbonate of lime, but is liable to melt into slag in burning, on account of the formation of fusible silicates of lime, alumina and oxide of iron. By careful burning it will make a tolerably good hydraulic lime.

This limestone occurs on the east side of the hill, near a pond; is stratified and runs N. 30° E., S. 30° W., and dips N. W. It is N. 30° W. from Lunenburg meeting house, and on the west side of the pond. The top of the hill is composed of a greenish clay slate of the Cambrian system, and dips N. W. 50°.

Erratic blocks of fine granite and of hornblende rock were seen on the top of this ledge; one of the latter is six feet in diameter, and rests on its point like a rocking stone. The following wood engraving represents its appearance and situation.

Erratic block of hornblende rock resting on argillaceous slate strata.

These erratic rocks must have traveled from a considerable distance to this place, since there are none such in the vicinity.

Dalton. Returning, we made some excursions in Dalton, in company with Mr. James B. Sumner, examining the slate hill four miles east of his house, and some localities of limestone.

The slate hill consists of a coarse variety of argillaceous slate, which in some places is

sufficiently sound and even to quarry for grave stones, the only use to which it has yet been applied.

Some specimens of a narrow bed of limestone, not more than a foot wide, were obtained and examined. It is a white crystaline carbonate of lime, of good quality, but does not occur in adequate quantities for economical use in making lime.

Near the slate hill, there is a mineral spring of some celebrity, which was visited and found to be a mild chalybeate water, which may be used as a tonic by invalids. This spring deposits a thin crust of bog iron ore. The pyrites in the slate rocks also, by decomposition, forms sulphate of the oxide of iron, which deposits in the low lands and on the surface of the slate rocks which border on John's river.

Returning through Littleton to Haverhill, we next visited the town of Lyman, traveling along the river road and examining the rocks at the narrows of Connecticut river, where argillaceous slate rocks in contorted strata prevail, and run N. 60° E., S. 60° W., and dip northwestwardly.

The river is at this place only five rods wide, and is confined by rocky walls of slate, while the road is excavated beneath the high precipitous rocks, the whole scene being quite picturesque.

On reaching Lyman Plain, we called upon Mr. Horace Duncan, who devoted sometime in assisting me in the examination of the town. He exhibited some small specimens of galena and copper pyrites, which were found in the vicinity, and then conducted me to all the places it was thought worth while to examine.

Several localities of bog iron ore were examined, on the land of Messrs. N. Batchelder, Moses Chase, Henry Marden and Mr. Sanborn.

Nathan Batchelder's bog iron ore is in a meadow in the northwest corner of Bath, on the Connecticut river. The ore is in lumps, like that found in ponds, and is mostly the apocrenate of the per-oxide of iron. Some specimens of limestone, from large nodules in the slate on the margin of Connecticut river, were also obtained. The nodules are eight inches in diameter, and are very pure limestone.

On Hinman's hill we observed some very well marked drift furrows and scratches, which have a course S. 5° W., and are parallel to the course of Connecticut river, but 500 feet above it. There are two sets of striæ on the ledge, which cross each other at an angle of from 7 to 10°. The strata of slate run nearly north and south, and dip 85° W.

A locality of zinc and lead ore was discovered near this place, and the veins were found to be from half an inch to six inches wide, having a course N. 11° W., S. 11° E.

On excavating, we found the following ores: black blende, copper pyrites, purple copper, argentiferous galena and iron pyrites. This vein is crossed by one running east and west, which is one inch wide, and contains the same ores.

They both widen rapidly as they descend into the rock, but there does not appear to be a sufficiency of ore to warrant the expense of mining in so hard a rock.

Ascending Lyman hill, on our way to Bath, drift scratches were observed on its summit, one set having a direction S. 25° E., and the other S. 36° E., the difference being 11°. The top of the hill is elevated 1117 feet above Connecticut river at Lyman.

On the eastern slope of this hill, in the town of Bath, veins of copper pyrites are found in the slate rocks, on the estate of Mr. H. Lang, and near the house occupied by his tenant, Mr. Leonard Hunt, who first noticed the ore, but was not aware of its nature.

Assisted by Mr. Lang, we examined this locality, and found that there were several small veins of the copper ore and some large detached masses. Two veins occur near the residence of Mr. Hunt—one on the margin of a small brook, in a ravine over the hill; and a large detached block of very pure ore, two and a half feet in diameter, was found in the meadow below the ravine, and must have been derived from some vein in the vicinity.

The vein on this hill runs N. 50° W., S. 50° E., nearly in the same direction with the slate strata. A cross vein, having a course N. 45° W., S. 45° E., is from one foot to eighteen inches wide, and is mixed with fragments of slate, forming with it a breccia. Over the hill, in the ravine, the vein is from four to eight inches wide, and a cross vein is two inches wide.

On the top of this hill drift scratches run as follows: S. 5° W., S. 10° W., S. 19° W. and S. 24° W., indicating much variation in the course of the ancient current which produced them.

The copper ore on this estate appears worthy of being wrought, and by mining operations it can be ascertained whether the veins continue to be rich, as they descend. By a single blast we raised nearly 100 pounds of good copper ore, which would yield about 20 per cent. of metal. The washed ore, by my assay, yielded 32 per cent. of fine copper, and contains 34 per cent.

Several localities of argentiferous galena exist in Bath, but they are all too narrow to warrant the expense of mining. One locality is on the Moor farm, another on the estate of Mr. Moses Bailey, on the east side of the hill. I have examined specimens of the ores, but want of time prevented my exploring the localities, rainy weather interrupting our researches when we were in that region.

Having obtained a large box full of the ores of this town, we sent them by team to Concord, and returned to Haverhill, and visited the Beaver meadow bog iron ore and the scythe stone quarries. The iron ore is in small quantities, being found only in scattered lumps, and is not worth digging out. The swamp is much more valuable for the swamp muck it contains, which is three feet deep and a mile long, by a quarter of a mile wide.

Excellent scythe stones are obtained near this place, and are made of a fine mica slate rock, which is quite soft and easily wrought. The strata run N. 35° E., S. 35° W., and dip N. W. 13°.

Revisiting Piermont, on our way to Warren, the iron mines of Mr. Cross' hill in Piermont, were examined at the new opening on the south side of the hill, where Mr. Paddock of St. Johnsbury, Vt., had extracted a large quantity of the ore. This opening served to give an idea of the immense quantity of iron ore contained in the vein, for it presents a section of the south end of the vein, and exposes fully to view a solid mass of specular compact micaceous and magnetic iron ore, from ten to fifteen feet in width. More than a hundred tons of the ore having been blasted out, was seen on the ground, and was ready to be transported to the furnace in Vermont, so soon as the winter's snow should lay

down a smooth road for the sleds. A zigzag road has been made down the steep side of the hill, by which the ore is removed to the main road leading to Haverhill.

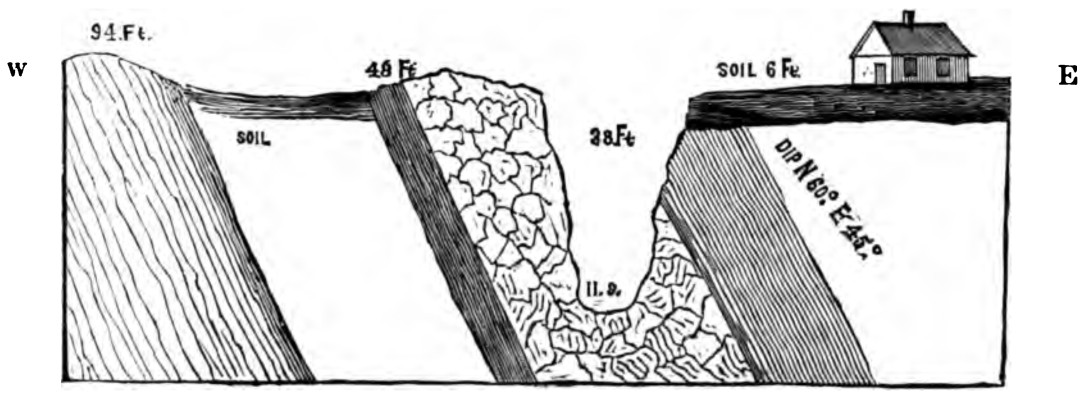
It seems strange that the ore should be transported to so great a distance to be smelted, when there are all the facilities that could possibly be desired for its reduction to iron, in the immediate vicinity—wood for charcoal being very cheap and abundant, limestone occurring in inexhaustible quantities in Haverhill, near Black mountain, while abundant water power may be obtained near the base of the hill. The demand for good iron in the immediate vicinity will require all the iron that a single blast furnace could make, and since the transportation from the cities on the sea board renders foreign iron dear, it will serve as a prohibition to its use, if the metal can be manufactured on the spot at a less cost than the price of foreign iron, with the cost of its transportation added to it. The effect of this natural protection would be $20 per ton in favor of the Piermont iron, that being the present price of transportation from Boston to Haverhill.

From the summit of Cross' hill a picturesque view of the surrounding country is obtained. On the south a little lake near the road below, and beyond the towering peak of Moosehillock mountain is seen, and on the west several conical peaks of granite mountains are in full view.

The hard quartz rocks on Cross' hill have not escaped the action of drifted rocks, sand and gravel; for their surfaces are smoothed, polished and furrowed, the striæ having a course S. 30° E.

After procuring an additional supply of specimens of the iron ore, from the new excavations at the south end of the hill, we rode on to the Warren copper mine, where, by the assistance of Mr. True Merrill, a more thorough examination was made of the mines, which had been more fully opened, so that a better view of the minerals could be obtained, and a series of specimens were procured, which enabled me to make all the requisite assays of the ore, and to supply the State cabinet with proper illustrations of the contents of the mine. A few new localities of interesting minerals were also discovered in the vicinity, and specimens were blasted out for examination.

The great bed of tremolite, including copper pyrites, was examined anew, and a plan was drawn from my measurements, as represented in the following diagram.



Plan of the copper mine in Warren.

The distances were measured from the eastern edge of the bed towards the W.

The known and measured width of the tremolite bed, containing the copper ore, is 48 feet, but the nearest wall rock on the west is 94 feet from the east wall of the bed; on the western side a covering of soil prevents our ascertaining whether the bed extends to the mica slate; the space is, therefore, left blank in the diagram.

Across the top of the opening of the mine, the width is 38 feet, and the depth of the excavation is 6 feet 5 inches through the soil, and 5 feet 4 inches in the tremolite rock, or 11 feet 9 inches in all.

The rock including the tremolite and the copper ore is mica slate, the strata of which dip to the N. 60° E. 45°, and the bed has the same dip with the strata.

In the eastern wall rock there are veins of the pure yellow copper pyrites, with veins of quartz. A bed of copper pyrites also occurs along the line of junction of the tremolite rock with the mica slate.

Several veins of copper ore, with large bunches of iron pyrites, and a resplendent black blende, are found in the midst of the tremolite, and occasionally some large crystals of rutile, or red oxide of titanium, accompany the iron pyrites.

Most of the tremolite is mixed with copper pyrites, and may be completely separated from it by stamping and washing. The rock contains from 6 to 12 per cent. of metal, while the pure ore yields 32 per cent. by assay, in the crucible, and contains 34 per cent., as proved by analysis.

Near the bottom of the present excavation, a large quantity of brown and green talc was discovered, in which a considerable proportion of copper pyrites was contained in alternating layers.

I have no doubt that if this mine is wrought with economy and skill, that it will prove profitable.

It is easy to drain it to the depth of 114 feet, without any machinery for pumping, since there is a rapid descent from the hill side to the brook along a ravine, which affords drainage in that direction.

The brook will furnish a valuable water power for stamping and washing the ore. Charcoal may be obtained in abundance at 3 or 4 cents per bushel, and the mica slate rocks will answer for building furnaces, which ought, however, to be lined with fire-brick. The quartz rock, which is abundant, will form a good hearth, or sole, for a reverberatory furnace.

Limestone, required for a flux, may be obtained in Haverhill in any desired quantity. It cannot be expected that a mine of copper pyrites will be wrought to advantage, by any one not already familiar with the business, and, thus far, no proper trial has been made of the ore in the large way.

My assays have proved that it may be economically reduced, after the method pursued in the copper furnaces of Europe.

A lease of the mine was given to Mr. H. Bradford and others, but was not retained by them, nor were any attempts made to reduce the ore to metal. The mine cannot be wrought to advantage, unless proper machinery for stamping and washing the ore, as it is got out, is put up, and two reverberatory furnaces are built for roasting and reducing the ore. Works for this purpose must necessarily involve a considerable outlay of capital,

and no one should engage in the work, unless he is prepared to accomplish it in a thorough manner.

The mine is now not properly opened, and, in future operations, it must be covered and protected from snow and rain, so that the work may proceed in the winter, when laborers may be hired for lower wages than in summer.

There is a small vein of copper pyrites distant forty rods S., 20° W. from this mine, on the land of Mr. Joseph Copps. The vein is in quartz, which is 20 inches wide, while the copper ore is but 1 or 2 inches thick. The vein runs N. W. by N., S. E. by S., and dips to the E. S. E. 20°. It is not of sufficient magnitude to be considered valuable.

Two miles and a half N. E. from this mine, copper pyrites, in small veins, has been found on the land of Mr. Stevens, but is not rich.

One hundred yards north of the tremolite bed, an extensive vein of black blende, mixed with copper pyrites and galena, has been opened, and the mine promises to be valuable.

The principal vein is six feet wide, and dips to the N. E. 50°, while the mica slate strata containing it, dip S. E. 44°, and are, likewise, intercalated with layers of the black blende.

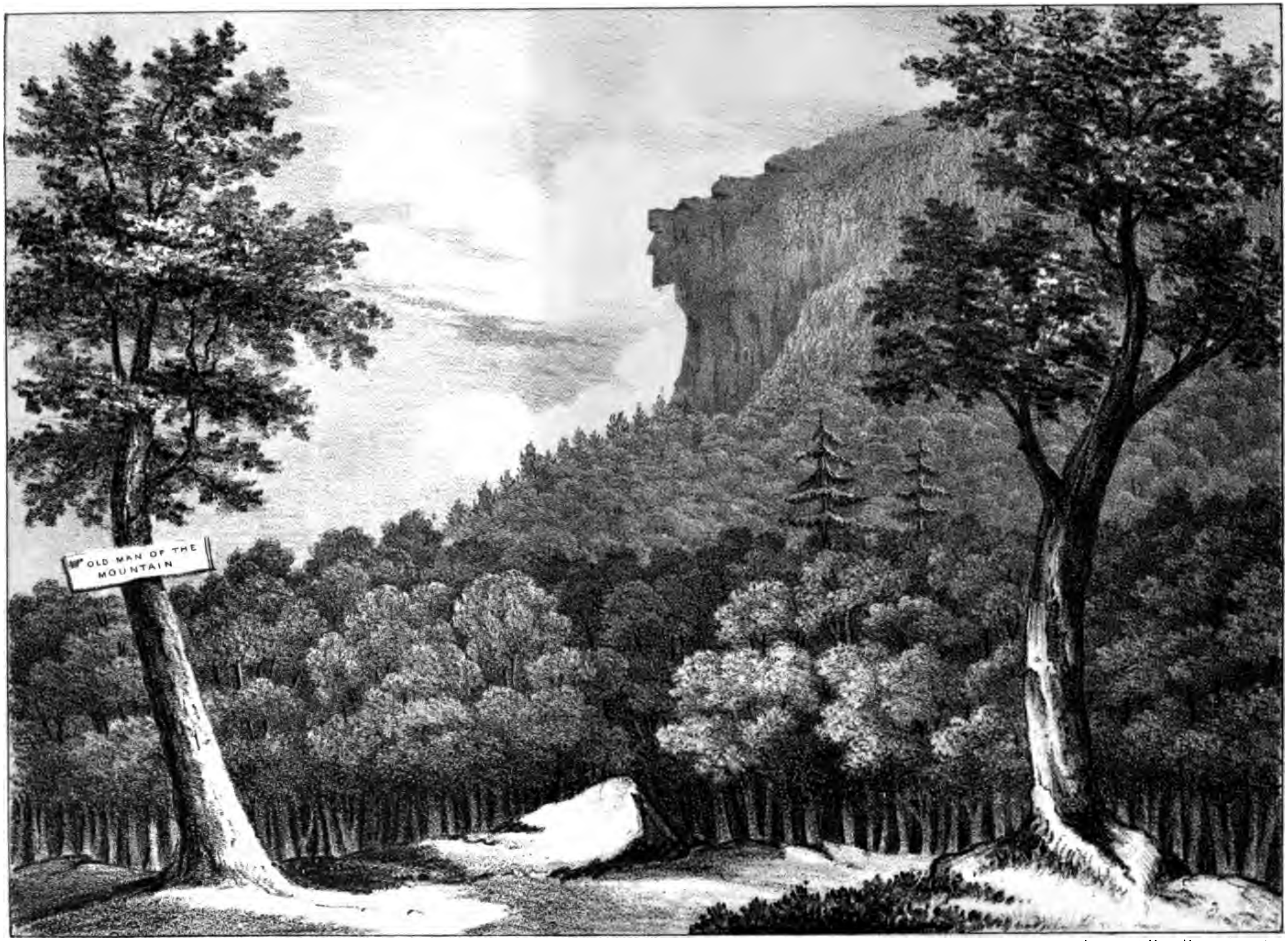
I have analyzed and assayed average lots of this ore, and have distilled from it from 20 to 30 per cent. of metallic zinc, by the usual process. Specimens of the metal were deposited in the State cabinet during the second year of the survey.

I regard this mine as valuable, and have no doubt that it will ultimately be wrought for zinc, but the process being a difficult one, and but few persons in this country being familiar with it, we cannot expect that zinc furnaces will be erected at present. The assays have proved that it can be wrought profitably by competent workmen.

Either copper and zinc may be manufactured at this place, or they may be combined in the form of brass. Experiments have proved that brass may be made from copper and roasted blende, without the trouble of distilling the zinc; the experiment having perfectly succeeded on the small scale in crucibles.

In preparing the zinc ore by washing, all the lead ore will be left behind, on account of its high specific gravity, and when a sufficiency of the ore is collected, it may be reduced to metal and then be cupelled for silver, the lead being converted into litharge, and sold in that state, or if preferable, may be reduced back to metallic lead. A considerable quantity of argentiferous galena may also be obtained in the copper mine, care being taken in sorting and picking the ore, and in the washing operations. It is essential that no lead ore should be mixed with the copper, for it would injure the quality of the metal. Fortunately, it is rarely mixed with the copper pyrites, but occurs mostly in the talc and brown mica.

Near the copper mines, a vein of largely crystalized epidote occurs, and had been mistaken for a zinc ore. On blasting this vein, immense crystals, of a beautiful green color, were observed, some of which are 8 inches in diameter. They are contained in quartz, and are very abundant. The smaller crystals are very perfect, and present several modifications in their crystaline form, that will prove interesting to mineralogists. Hemitropic crystals, with salient angles at one end and re-entering angles at the other, are most abundant.



PROFILE MOUNTAIN. FRANCONIA NOTCH.

The large crystals are apt to be shattered to pieces by blasting with gunpowder; hence only a small charge should be used, merely to crack the rock, which may then be forced apart by the crow-bar and broken up by a heavy sledge hammer, so as not to communicate the vibrations too powerfully to the crystals.

Leaving Warren, we passed through Orford and Lyme to Hanover, and there had an opportunity of examining a specimen, which had been sent to the college cabinet, by some citizen of New Hampshire who had neglected to give his address or the locality of the mineral. From the nature of the rock attached to it, I suppose it came from the slate region bordering on the Connecticut river, and by subsequent comparison, I concluded it might have been obtained from some of the rocks of Cornish.

This mineral, which I partially analyzed in Prof. Hubbard's laboratory, and subsequently analyzed in a more thorough manner in Boston, was found to consist of

Antimony, - - -	28.621
Copper, - - - -	28.337
Iron, - - -	11.090
Silver - - - -	3.900
Sulphur and loss, - - -	28.052
	100.000

It is associated with yellow copper pyrites, which forms a distinct vein on one side of the antimonial ore. The gangue is hard clay slate with quartz.

Its specific gravity is 5.028. It is of a bluish iron grey color, is easily cut with the knife, and, when heated before the blowpipe, it gives off the odor of sulphur and antimonial fumes, which condense on the charcoal, and the residue being reduced with soda, a bead consisting of an alloy of copper, iron and silver, remains.

It is a grey antimonial sulphuret of copper, iron and silver, and is a very valuable ore.

Every possible exertion was therefore made to discover its locality, but without any satisfactory result. (See remarks on Cornish.) Should any one know the locality of this ore, and will furnish me with specimens of it, I shall be happy in giving information respecting the method of working it; having now a small piece of it in my possession, it will be easy to identify it with the ores which may be sent to me, if they are of the same kind. It will prove to be a very valuable ore; for it is easy to extract the silver from it in the large way.

Leaving Hanover, the rocks of Lebanon and Plainfield were examined, and several beds of limestone were explored and specimens obtained for analysis.

In Lebanon, Mr. Colby C. Benton exhibited a collection of specimens of minerals, mostly obtained in his neighbourhood, and with us visited such localities as were deemed worthy of examination.

On the land of Mr. Abner Allen, a deposit of bog iron ore occurs, and is of very recent origin, as is evident from the remains and casts of beech-nuts, roots and leaves found in it. The ore is on the margin of a brook which passes along the hill side, and occurs in lumps of considerable magnitude, and in the form of a thick hard pan. It may be traced to its origin in the decomposition of iron pyrites, which abounds in the rocks at that place.

It has been used for paint, and seems to be well adapted to that purpose, but is in such limited quantities, and so near the pyritiferous rock, from whence it originated, as to render it of no value for making iron.

Masses of quartz containing iron pyrites and galena, are found in the stone walls, but there is no regular vein of the lead ore of any value on the farm.

Galena has also been found near the village of Lebanon, in veins of quartz, but is not in sufficient abundance to prove valuable. Iron pyrites abounds in the rocks in the village. Brown epidote is found in the quartz rocks, and loose masses of arsenical pyrites and hæmatite iron ore are found in the soil. Drift scratches, running north and south, are abundant on the ledges of Mr. Allen's farm. The rocks are argillaceous slate, the strata of which dip W. 85°.

CHARLESTOWN. This town is situated on the alluvion of the Connecticut river, which rests on blue argillaceous slate, passing by imperceptible gradations into mica slate, the rocks being of the metamorphic or Cambrian system. Two miles from the village, the strata crop out and dip to the southeast, and quartz veins or beds are contained between the strata

Accompanied by Dr. Samuel Webber, a gentleman who has devoted much attention to the mineralogy of the town, I visited every locality that was deemed interesting, and collected specimens of the rocks and minerals.

A deposit of bog iron ore occurs on the estate of Mr. William Briggs, two or three miles S. S. E. from Charlestown village, on the hill side, which covers an area 50 yards wide in a north and south, and 100 yards in an east and west direction.

A chalybeate spring rises in the midst of this deposit, and is strongly charged with iron. Yellow ochre, suitable for paint, is abundant and of good quality. The bog iron ore, when pulverized, washed and roasted, will form a very fine red ochre. This ore was formed by the decomposition of the iron pyrites contained in the slate rocks, per-sulphate of iron being produced by its oxidation; and this sulphate on coming in contact with the vegetable acids of the soil, was again decomposed, the oxide of iron being precipitated in combination with them. The apocrenate of iron being the most insoluble of these combinations, forms the chief deposit in bog iron, while the crenate and humate are in part washed out by the action of water.

By chemical analysis of 100 grains of this ore, it was found to consist of

Water,	6.60
Organic or vegetable acids of the soil,	18.60
Insoluble siliceous matter,	4.60
Per-oxide of iron with a little oxide of manganese,	69.40
Sulphuric acid,	48
	99.68
Loss,	32
	100.00

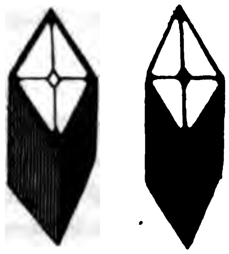
It therefore contains 48.1209 per cent. of iron. After being properly roasted to expel the sulphuric acid, it will make good cast iron, but the deposit is not of sufficient extent to

warrant the erection of a blast furnace. It may prove valuable to mix with other heavy iron ores, and will facilitate their reduction. There are furnaces in Vermont, which receive bog iron ore brought from places thirty miles distant

On the road to the iron ore above described, we examined a locality first noticed by Dr. Webber, where some very curious macle crystals, are found in loose rocks, and soon after we found them in place in the slate ledges. They are crystals of andalusite and staurolite macle, the latter being a new variety.

The andalusite macle is found in the softer and more argillaceous slate rocks, while the staurolite macle occurs in the micaceous slate.

The following wood cut exhibits the forms most prevalent in the staurolite macles, and is the same that was made from specimens in my collection for Alger's edition of Philips' Mineralogy. (See p. 112 of that work for a more detailed description of this mineral.)



It evidently passes by imperceptible degrees into a hydrous species of andalusite, which often invests the crystals with a pearly crust. The hydrous andalusite is much softer than the anhydrous species.

Both the hydrous and anhydrous andalusite macles are found in Charlestown, and are like those which occur in Lancaster, Massachusetts. (See a description of this mineral in Algier's edition of Philips' Mineralogy, p. 119, and Boston Journal of Natural History, Vol. 1, 1834.)

On the top of the hill above the iron ore deposit above described, there is a bed of conglomerated quartz pebbles, and not far beyond this Dr. Webber has noticed the occurrence of granite. It may, therefore, be supposed that the argillaceous slates have undergone their metamorphosis, through the influence of the neighbouring granite rocks.

The soil of Charestown is good, and is mostly derived from the ancient deposits from the Connecticut river, which in former times flowed at higher levels, and left terraces of fine sedimentary matter in its course.

These terraces have been described by Dr. Webber, in a communication to the National Institute at Washington.

UNITY. On revisiting this town we examined the iron and copper pyrites mine of Mr. James Neal, and a new locality, where an ore of titanium was found associated with magnetic iron ore. This new locality is an E. and W. vein, which traverses the strata of micaceous, hornblende and chlorite slate rocks, that run N. by E., and dip S. 80°. The titanium ore is on the north side of the iron ore vein, in quartz, and is 3 or 4 inches wide, while the iron ore is two feet wide, and runs E. by S. Rhomboidal masses and crystals of the titanium ore, six inches in diameter, are obtained from the quartz.

White iron pyrites occurs on the south side of the vein, with crystals of chlorophyllite, from two and a half to six inches in diameter. It is found on the east side of the road, near Little Sugar river, eighty rods south from Mr. Neal's house. The copper and iron pyrites mine presented nothing new, not having been wrought since our former visit. (See description of this mine in the first annual report.) A few good specimens were selected and submitted to analysis and assay.

The titanium ore was found to be a titanite of iron, from which titanic acid, for porcelain works, may be extracted in abundance. It is not pure enough to be used before preparation by chemical means. (See analysis of this ore.)

Returning to Claremont, excursions were made to Cornish, Plainfield and to Ascutney mountain, in Windsor, Vt., and several localities of useful minerals were examined.

The height of Ascutney mountain was measured by the sextant and by the barometer, and found to be 2838 feet above the meadow at Westfield bridge, and 2736 feet above the Windsor house, or 3104 feet above the sea.

The latitude of Windsor, by meridian altitude of the sun, was found to be N. 43° 28′ 59″, and that of Chase's tavern, in Cornish, was N. 43° 28′ 55″.

In Cornish much time was spent in endeavoring to discover the original locality of a specimen of antimonial silver ore, which I had examined in Hanover. Many individuals in the town had specimens resembling it, which were said to have been blown out while building a saw mill on Bryant's brook, some fifteen or twenty years ago, but no very definite information could be obtained.

Specimens of antimonial ore were seen in the collections of Messrs. Samuel Chase and B. N. Comings. A fragment was also obtained from widow Chase, who stated that it was found in building the saw mill on Bryant's brook. It was an antimonial ore associated with bright yellow copper pyrites, like the specimen I had examined. On searching at the mills, no vein of it could be discovered, and the water in the river and in the flume, where the ore was supposed to have been found, prevented any examination there. Coming's mills, and every other place where it was supposed to have been found, were examined in vain, and we were obliged to abandon the search without finding the locality, but still believing that it must occur somewhere in the vicinity. On visiting Concord during the session of the Legislature, I was informed by Mr. Reuben Davis, the representative of Cornish, that he carried the specimen, I had seen, to Hanover, and that he believed that he knew its locality. I have seen him since, but he has not found it, though he is not disposed to give up the search.

Among the minerals collected by Mr. Samuel Chase, were crystals of red oxide of titanium, which were found in loose blocks of mica slate, one and a half miles east of Windsor bridge, hæmatite iron ore, garnets and bog manganese. Most of these specimens were found in loose rocks, and are only interesting in connection with the history of transported or drifted rocks, the titanium ore being identical with that found at the lime quarries in Orford.

Spruce yellow paint is found on the bottom and on the margin of Bryant's brook. It is a kind of clay colored by yellow ochre, and is of a very delicate pale reddish yellow color.

Iron pyrites is found at Coming's mills in a hard quartz rock. Limestone is found on the estate of Judge E. Jackson, on Cornish Flat. It is of a blue color, and is traversed by white veins of pure carbonate of lime. On analysis it was found to be of a good quality for burning into lime. Good limestone is also abundant on the land of Messrs. Samuel Johnson and Charles Eggleston, in Plainfield.

The strata run N. 12° E., S. 12° W., and dip W, 70°. It is a yellowish and grey colored limestone, and is sufficiently pure to burn into a good strong lime. A little of it was burnt by Mr. J. Spaulding, who found it made a good durable mortar. It is also suitable for agriculture. Specimens were taken from every part of the bed, where it seemed to vary in quality, and were subjected to analysis in my laboratory. I learned that limestone is also found on the land of Messrs. Abel Demming, Aaron Smith and Benjamin Smith.

Rev. Alva Chapman showed us a specimen of transparent quartz, traversed by numerous acicular crystals of rutile. It was found on the farm of Mr. Benjamin Chapman, about twenty years ago.

On visiting Mr. B. Chapman's collection, we saw another piece of the same mass, and learned that it was originally a smoothly rounded boulder, about the size of a man's head. It was ploughed up from the soil. This mass has been broken up, and pieces of it have been given to several mineralogists. It is supposed that the specimen in Dartmouth College was a portion of this mass, but the titanium crystals in that specimen are of a deeper red color.

When the crystals of oxide of titanium are of fine color, and are grouped in fine fasciculi in transparent quartz, the stone is very highly valued by lapidaries and jewellers, who sell it under the name of Venus Hair Stone.

The original bed, or vein, from whence this mineral was derived, is unknown, but I suppose it may have originally occured in place in Lyme or Orford; since the same mineral is found there in the quartz crystals at the lime quarries, and the known course of the current would have brought them to the spot, where they were found with other drifted boulders.

Prof. Hubbard thinks that the specimen in Dartmouth College cabinet, which has been there for many years, was found somewhere in the town of Hanover. The specimen which I saw in the hands of Mr. Chilton, in N. Y., is exactly like it, and probably came from the same locality that furnished the Hanover specimen; still they may both have been drifted rocks from Lyme or some other northern district.

During an excursion through the Franconia notch to the White Mountains, on our way to Jackson and Shelburne, the following sketch of that remarkable natural curiosity, the Profile or Old Man of the Mountain, seen from the Franconia notch, was drawn by one of my assistants. It represents the details of that curious freak of nature, as more distinctly viewed through a telescope; and since this sketch will enable the reader to understand better the structure of the profile, which is also exhibited in the lithographic view of the mountain, accompanying this report, it is here introduced.

Telescopic view of the Profile Mountain, Franconia notch.

The profile is produced by the irregular jutting out of five blocks of granite, which project in the manner above represented, giving the effect of the stern visage of an old man looking over the deep valley below, and having so strong a likeness to a human face as to be regarded an object of wonder and admiration, worthy of a visit from travelers. It has been declared to be "one of the greatest natural curiosities of the State," and so many incorrect drawings of it have been made, and occasionally published, that I have thought it worthy of a correct delineation in this report.

It is said that the view of the profile is lost when the mountain is approached, as it is also by a considerable change in the point of view on the road; the best spot to see it to advantage, being where the guide board directs the traveler's attention to it.

Various traditionary tales, evidently of recent origin, are related respecting the superstitious awe, with which the aboriginal inhabitants viewed this collossal profile. It is a proper object for romantic legends, but there is no proof that it was known more than forty or fifty years ago to the white men; nor does history inform us that it had been observed by the Indians.

An account of our researches in Jackson and on the Pinkham road, which leads along the eastern side of the White Mountains, has already been given; also a description of the mines and minerals of Shelburne. A sketch of the White Mountains, with an account of Mr. Channing's excursions, is here inserted.

While in Shelburne, the following sketch of Mount Jefferson and Mount Washington was drawn. It exhibits the appearance of the White Mountains from their northern side, a view which is quite characteristic of that mountainous region.

The intervening country is thickly clad with primeval forest trees, and has been but little explored.

View of Mount Jefferson and Mount Washington from Shelburne.

On reaching Kilkenny, Mr. Channing was desirous of exploring the south branch of Israel's river, where we had been told that large plates of mica abounded, and in company with Mr. Edward Hale of Boston, he traversed the wilderness along that stream, searching for the mineral, and ascended and crossed over the summit of Mount Washington to the notch. His journal contains the following description of this fatiguing excursion:

"Mr. E. Hale and myself, with Mr. J. J. Martin for guide, set out at 6 1-2, A. M., Sept. 4th, to ascend the south branch of Israel's river, on which it was stated that large sheets of mica, of incredible size, occured in place. Following the stream towards its sources, and traveling amid dense woods, here and there obstructed by undergrowth, the forest trees became more stately and the scenery more wild as we proceeded.

This unfrequented stream is full of trout, and the foot tracks of deer were seen quite abundantly in the soil. We traveled up in the bed of the stream, and observed that the rocks exposed to view were ledges of granite, becoming coarser as we proceeded, and containing small plates of mica, not more than an inch square. Loose masses of hornstone or jasper, were observed among the pebbles in the stream. No plates of mica, such as had been described, could be found, and the tradition respecting them is probably erroneous.

At noon the guide was discharged and the river was traced to its sources, search being made for the mica. We passed a branch of the stream, which enters it at right angles, from the eastward, and appeared to have taken its rise on the side of Mount Adams, but we had not time to explore it.

The branch which we followed, ascended rapidly, and tracing its course, we finally came to its source, near the summit of Mount Jefferson, at nightfall, having traveled for 12 hours through the woods. The distance is probably not more than 14 miles from this spot to Kilkenny. No mica of any value was found, but an abundance of fibrolite or fibrous kyanite occurs on Mount Jefferson and Mount Washington." Messrs. Channing and Hale reached the side of Mount Washington at 9 o'clock, and passed a rainy night in a rough

shed, built for the accommodation of travelers. The next morning they completed their examination of the mountain, and descended to T. J. Crawford's, in the notch, having performed a journey which probably few, if any travelers, had effected before. Although disappointed in not finding a mica quarry, the results of this exploration were important; since the observations made in the bed of Israel's river prove the nucleus of the White Mountain range to be granite rock, and the mica slate seen on the summit of the mountains, is but a superficial crust or superimposed layer.

Outlines of a section across the State of Vermont.

A rapid exploration of the nature and order of superposition of the rocks of Vermont, was made for comparison with those to the eastward of New Hampshire, and the results of this comparison being of geological importance in relation to the history of the rocks of the latter State, a brief sketch of the section is here offered.

Having some years since had occasion to explore the geology of Nova Scotia and a part of New Brunswick, and having subsequently made a geological survey of the State of Maine, which is sufficiently complete to exhibit the boundaries of all the rock formations of that State, I was prepared for the examination of Vermont, where rocks of the same nature with those of Maine are found, forming in fact the counterpart of the disrupted strata on the eastern side of New Hampshire, which is in the axis or centre of elevation. A sectional profile, accompanying this report, will show the relations of the rocks on each side of this axis, the rock formations, omitting minor details, being therein represented. After giving the details of our observations in Vermont, I shall revert to some general or theoretical conclusions, in which the relations of the rocks to each other will be considered.

Crossing the Connecticut river at Lancaster, we came to Lunenburg, Vt., where a bed of limestone was formerly examined, (p. 147.) The principal rocks in this town are mica slate, the strata of which dip very boldly to the N. W., and a greenish Cambrian clay slate, with a less steep inclination to the N. W., and occupying the summit and side of a steep hill, where a bed of blue limestone occurs imbedded in the slate.

On the road to St. Johnsbury, Vt., four miles beyond Concord, Vt., blue argillaceous slate rocks occur, and dip to the S. E. 70°.

The surface of the ledges is deeply scored with furrows and scratches, running S. 5° E. and S. 10° E., and varying in depth from $\frac{1}{4}$ to $\frac{1}{2}$ inch, while they are generally from $\frac{1}{2}$ an inch to 1 inch wide. Broad trough-shaped furrows have also been ground out in the slate by the action of drifted sand and gravel. The height of this place above the bank of of Connecticut river, at Lancaster, is 647 feet.

Half a day was spent in St. Johnsbury, in company with Mr. Huxham Paddock, who furnished much valuable information respecting the iron ores of New Hampshire, which he obtains from several places on the borders of Connecticut river, viz : from Lyman, distant 14 miles, Bath, 17 miles, Piermont, 34 miles, and from Col. White's farm in Lancaster. These ores he mixes with the refractory titaniferous magnetic iron ore brought from Troy, Vt., distant 45 miles from his furnace. (See article *Metallurgy of Iron.*)

The following is a description of the country from Lancaster.

In Lunenburg we pass over intervals of considerable width, favorably situated for grass meadows, being flowed during the freshet seasons. We next ascend hills of mica slate rocks, the strata of which are nearly vertical. The rocks continue the same until we reach Concord, Vt., and four miles beyond that town the argillaceous slate is observed, dipping in an opposite direction, or S. E. The country is rolling or hilly, and the soil is clayey and retentive of moisture.

From St. Johnsbury to Cabot, Vt., the rocks are mica slate, of an ash grey color, and resemble limestone in appearance. Three miles beyond Cabot, we saw the beautiful Winooski falls, which is a cascade of foaming water, dashing over successive steps of mica slate, and falling about 100 feet. A few miles farther westward, we saw granite veins cutting through the mica slate, and having a north and south course. Grey limestone occurs in the stratified rock, and dips N. W. 40°, with the strata.

In Montpelier, an abrupt hill of mica slate is seen in the rear of the State House, and the strata dip to the N. W. The State House is constructed of a beautiful light colored granite found in the town of Barry, eight miles south of Montpelier. The columns of this splendid structure are 36 feet high, and are of the fluted doric order, the flutings being 10 inches wide. The columns are jointed. The interior is adorned with smoothly cut darker granite columns of the Ionic order. After a hasty glance at this town, we traveled on towards Burlington, and observed on the way that after passing the toll house, where the mica slate rocks dip N. W., they become vertical, and then their inclination is reversed, or their dip is to the S. E. We came next to a hill of granite, covered with drift scratches, running S. 52° E., or in the line of direction of the valley of Onion river.

In Richmond, 26 miles from Montpelier and 13 from Burlington, the rocks are grey mica slate, dipping to the S. E. At this place they change their character, the mica slate ceasing, and the limestones with their associated siliceous strata take their place, and alternate with each other.

At Burlington falls, the red sandstone above alluded to, (Potsdam sandstone of Emmons,) contains numerous beds of buff colored and blue compact limestone, destitute of fossils, and apparently suitable for the manufacture of hydraulic cement.

In company with Prof. Benedict of Burlington College, the rocks of this town were hastily examined.

At Willard's quarry, the red sandstone rock alternates with a bright red slate, covered with ripple marks made by the waters, from which the sediment was originally deposited. A few concretions, which look like siliceous substitutions of fuci, occur, but they are not sufficiently distinct to be determined. The strata dip from 8 to 10° E. S. E.

A mile from the town, on the Winooski stream, large beds of compact blue and excellent white limestone abound, and are wrought for lime near the High bridge. This place is very remarkable, the High bridge being thrown across a deep chasm in the compact limestone rocks, through which the river has cut its way. The rock is cleft more than 100 feet perpendicularly, and the river rushes through the gap, the whole forming a picturesque scene, often visited by travelers. The limestone strata extend to Williston, 10 miles east of Burlington.

Proceeding eastwardly, the strata are more and more disturbed, and evince distinctly the action of the igneous rocks, the whole series being evidently more or less altered by heat.

On the opposite side of Lake Champlain, and also on its southeastern shore, the limestones are of a very dark blue color, and are replete with fossil shells of the lower Silurian system. So, also, at its northern extremity, in Canada, the fossiliferous limestones abound, forming large horizontal sheets of strata, which constitute the base of the table lands of La Prairie and the country around Montreal.

Mr. Channing, in company with Mr. E. Hale, made an excursion across Vermont from Lebanon, through Bridgewater, Woodstock and Shelburne, following White river, and crossing the Green Mountains to Whitehall. His observations confirm my views with regard to the order of strata of Vermont, and their relations to the rocks of New Hampshire.

The limestones were observed to be more crystaline to the eastward and on the sides of the Green Mountains, and more compact, as he proceeded towards lake Champlain, where they are filled with, and almost made up of fossil shells of the lower Silurian group.

In the north he found the same state of things prevailed on the Canada frontier. He noticed the remarkable change which takes place in the aspect of the country, in passing from the highly inclined strata of mica slate to the flat sheets of fossiliferous limestone, which underlie the soil of the northern part of Vermont and New Hampshire, and form the table lands in Canada. He remarks that Hall's stream is 10 or 12 feet wide at its confluence with the Connecticut, which is 20 or 30 feet wide, both streams being quite shallow. Hall's stream has an alluvial valley, with an intervale as broad as that of the Connecticut. The inhabitants on the Canada side are Frenchmen. The scenery below Hall's stream is highly picturesque. The rocks are mica slate, and the soil is good, bearing a heavy growth of sugar maples. The soil on the primary rocks in the northern part of Vermont, New Hampshire and Maine owes much of its fertility to the soil formed from the limestones of Canada, the detritus of which was transported southward at the drift epoch, as is clearly manifested by the abundant boulders and fragments in the soil.

This section connects the surveys of New England with that of New York, and being thrown over Vermont, gives a continuous line of observations, which has been carried by me from the Gut of Canso, in Nova Scotia, to New York, and the surveyors of that State have connected theirs with the surveys made by the State geologists of Pennsylvania, Ohio, Indiana and Kentucky; so that the order of strata is pretty well known to the borders of the Mississippi river; and by future observations it is to be hoped that this section may be explored quite across the continent to the Pacific ocean.

Returning to New Hampshire, a section was roughly explored from Middlebury, Vt., to Orford.

Near Middlebury the rocks are the red compact sandstone, like that of Burlington, associated with a coarser conglomerate, containing sharp angular fragments of quartz and beds of compact limestone. The strata of limestone dip S. E. by E. 25° to 30°.

White marble, of great beauty, is found in the east part of the town, and has recently been quarried. It was discovered in the spring of 1840, and is owned by Messrs. Ormsby,

Phelps and Slason. Some good blocks have been got out, which are suitable for monumental work or for sculpture.

Two miles north of this, another quarry of white marble has been opened by Messrs. Case and Spaulding, and large blocks have been obtained. It also abounds at Brandon, Vt., where the most beautiful slabs have been wrought, and at Rutland, Vt., where a number of extensive quarries have been opened.

On examining the marbles on the western side of the Green Mountains, it was observed that there is a change of color in the stone, and a more distinct granular structure as they approach them, the rock passing through all the successive shades, from black to blue, red and dove colored to snow white, while the dip of the strata, from nearly horizontal, is more and more highly inclined, indicating a remarkable disturbance. The white marble *apparently* dips under the Green Mountains, but it is highly probable that this is only a folding or doubling back of the strata, which may curve round and pass down towards the shores of lake Champlain, where the same strata may be composed of marine shells. A more full examination is required to decide this question absolutely, but the theory above given explains the facts at present known.

The rocks on the Green Mountain range in this part of the State, are mostly composed of compact quartz, which must have had an igneous origin, if the above mentioned metamorphosis of shell limestone is to be attributed to its eruption.

Ores of the metals, iron, lead, zinc, copper and manganese, are abundant among the Green Mountains, and are wrought in a few places.

On the road over the mountains the compact quartz is seen in thick tabular masses, inclining to the eastward.

The height of the ground at Smith's tavern in Ripton, Vt., is 1202 feet above the sea level, and the top of the mountains, on an average, cannot be more than 2000 feet above the sea, although occasionally some of their peaks shoot up beyond 3000 feet.

Alternations of quartz rock, micaceous chlorite and clay slate rocks make up the series of strata from the Green Mountains to the Connecticut river. Beds of limestone and mountain masses, of a beautiful green serpentine, highly valued as a marble, soapstone and spotted marble, large deposits of iron pyrites, used for making copperas; veins and beds of iron ores and manganese are found in these rocks. Roof slates are abundant in the southern part of the State. It is evident from the foregoing examination that the rocks of Vermont correspond to those in Maine, the Cambrian group in Maine being much thicker, so as to throw the Silurian rocks of the eastern part of the State farther to the eastward. In Vermont the calcareous deposits generally are much purer on the western side of the Green Mountains, than they are in the corresponding geological district in Maine. So, also, the trilobite limestones of New York are more calcareous, than the same formation in Lubec, Me., and on Moose river, near Annapolis, in Nova Scotia, the rock at the latter place being slate, almost devoid of carbonate of lime. As we proceed northwardly in Maine, we find the secondary strata approach the meridian, so that on a northern section, parallel to the Kennebec river, we meet with the sandstones containing Delthyris shells, like the same rocks in New York. This fact is also observed in New Hamp-

shire and Vermont, which is owing to the northeastern trende of the secondary strata, that overlap the primary rocks.

If a measure is applied to a correct map of the northern and middle States, taking the White Mountains for a centre, and measuring S. W. and N. E., it will be noticed that the secondary rocks are nearly equi-distant from this centre of elevation, on each side of the axis, and the beds and included fossils will correspond in a remarkable manner, indicating that when the strata were horizontal, they formed a continuous deposit, effected under nearly the same conditions.

If we estimate the strata of Vermont and Maine as horizontal, by imagining the primary rocks which separate them, to be removed, and the lines of stratification brought to coincide in direction, it is evident that the whole of New England would be regarded as sunk far below the level of the ocean, and a space would still remain between the ends of the strata, where the primary rocks had been removed. Now, since the strata were formed when the present rocks were beneath the sea, we may suppose the whole of the primary unstratified rocks to have been below the stratified deposits, and by a sudden outburst and elevation, to have been more or less broken up, altered in composition, and included between masses of the molten gneiss and granite. Thus, we may account for the loss of a portion of the disrupted strata, while we also explain the intercalation of masses of argillaceous slate in the primary series, and the metamorphosis of the sedimentary deposits by igneous action. A heaving sea of molten rocks, probably bearing on its surface the sedimentary strata, elevated, overturned and effected chemical changes in them, the results of which we behold along the line of junction of the two classes of rocks.

The reader would be able better to conceive of this state of things, by the contemplation of the breaking up of a volcanic crater, or may figure the scene in his mind, by imagining a frozen lake with successive and thick layers of snow and ice, to be broken up by an earthquake, and the whole mass suddenly frozen while in the highest state of disturbance. This, however grand the scale, would not give a sufficiently enlarged idea of the vast movements of the earth's crust, nor of the changes which the materials must have undergone in the immense periods of geological time; for the action of a comparatively moderate heat for ages, effects changes in the position of elementary particles, which are not duly appreciated. This hypothesis will appear more plausible to those, who will take the trouble to go over the ground from one end of the section to the other, noting the changes which are manifested in the order of strata, and considering the known causes of chemical action on the ingredients of rocks. It will be observed that the sedimentary deposits have all been disturbed by upheaval, and that portions of strata are included in the unstratified rocks, showing their posterior eruption, while in some places the fracturing of strata has been still more remarkable, a complete breccia being formed with their comminuted fragments, and the thick pasty rocks of eruption.

Occasionally, the mechanical power of elevated granite is manifested by the complete overturning, or doubling back of large sheets of mica slate, and its chemical effects are seen in the remarkable induration of the rock along the line of junction, those slabs, when not bent, being chosen by the quarrymen on account of their superior firmness.

ECONOMICAL GEOLOGY.

Under this head, I shall consider the nature and uses of some of the most important minerals of the State, and their applications to the ordinary purposes of life; also the nature of soils and the methods of rendering them more fertile.

The following list comprises the most important minerals of economical value, found in New Hampshire.

Quarry Stones.

Granite, Sienite, Gneiss, Mica slate, Talcose rock or soapstone, Argillaceous slate, Granular quartz, Milk quartz and Limestone.

Stones used for other purposes.

Novaculite, (oil stones and hones,) Scythe stones, Felspar, Mica, (in large plates used for stove windows, lanterns, compass cards, &c., &c.,) Hearth stones for furnaces, (consisting of granular quartz, talc or mica,) Fluor-spar, Sulphate of barytes.

Precious stones.

Beryl, (aqua marine,) Iolite, Garnet, Amethyst, Quartz crystals, (limpid, smoky and containing acicular crystals of red oxide of titanium.)

Earthy minerals and paints.

Infusorial silica, (used for polishing powder and for making tripoli;) moulding sand, (used also for making Bristol brick;) clay, (used for brick making and pottery;) calcareous marl, (used in agriculture and for making lime;) red, yellow and brown ochres; spruce yellow ochre; bog manganese, (used for umber paint and for disengaging chlorine;) molybdena ochre; yellow blende, (used also for paint;) black lead or graphite, used for pencils and for making melting pots for copper founders; (about half the quantity used in New England being obtained from the mines of New Hampshire.) Copperas and alum formed by the decomposition of iron pyrites in the rocks, both abundant enough, but of little value, since they can be more cheaply extracted from the ores by art.

Metals.

Without regarding the metallic bases of the earthy and saline minerals, there are found in New Hampshire seventeen metals, viz:

1. Iron—Ores abundant and valuable, particularly those of Bartlett, Franconia and Piermont.
2. Zinc—The sulphuret and carbonate. Three mines worthy of being wrought, viz: Eaton, Warren and Shelburne.
3. Copper—Two mines of the sulphuret of copper and iron regarded as valuable.
4. Lead—Ores worth working in a few mines, both for lead and silver.
5. Tin—Five veins of the oxide of this metal discovered in Jackson.
6. Antimony—Two localities, but not abundant enough to prove valuable.
7. Silver—In one of the antimony ores, and in all the lead ores.
8. Gold—Minute quantities in Grafton and Canaan brown pyrites.
9. Molybdenum—Abundant as a sulphuret and oxide.
10. Manganese—The bog manganese very abundant.
11. Chrome—Minute quantities found in Dublin soils—origin unknown.
12. Titanium—More abundant in New Hampshire than elsewhere, but is a rare ore.
13. Cadmium—In all the zinc ores, but the Shelburne black blende is the richest.
14. Cobalt—In the Danaite or mispickel of Franconia—rare.
15. Arsenic—Very abundant, both native and in the state of arsenical pyrites.
16. Tungsten—Combined with manganese and oxide of iron. Jackson tin mines.
17. Uranium—In the molybdena ochre of Westmoreland—rare.

Granite is so common a rock in New Hampshire that but little value is attached to it, loose blocks, such as are found scattered over the surface, furnishing most of the stone required for underpinning and building. Good quarries of the first quality of granite are more rare, but many are wrought to a limited extent, furnishing as much stone as can be readily disposed of in the vicinity. When remote from a market, and requiring transportation by land, it is rarely worth the expense of quarrying; hence many ledges of good granite in New Hampshire are neglected. The value of this excellent building material is more sensibly felt, when it is with difficulty procured, and it is probably undervalued on account of its abundance, and is not so extensively employed in architecture as would be consistent with a far sighted economy. Granite buildings, properly constructed, may be built at a very little higher cost than those of wood, and have the advantage of permanency, while they are impervious to moisture, and retain a more uniform temperature in the apartments and are less liable to be injured by fire. As wood becomes more scarce, most of the wooden buildings in the State will be replaced by permanent granite structures, more suitable to resist the inclemency of the seasons. The value of granite for underpinning for houses and barns, for bridges, stone walls and for millstones is more fully appreciated.

Good granite, free from iron pyrites, is, when not exposed to the action of the soil, a perfectly permanent stone, and is admirably adapted to withstand all the usual causes of de-

cay. In this climate it is far more durable and sightly than marble, which appears too cold, and is liable to corrosion by mosses, and to disintegration by freezing water.

Impure granite disintegrates in moist soil with rapidity, and from its decomposition most of our New England soils and clays were derived. Its felspar and mica furnish the potash, soda and a portion of the lime, which enter into the composition of all plants, from the lowly herb to the stately trees of the forest.

Sienite is mineralogically composed of felspar and hornblende, with variable proportions of quartz, and occasionally contains a little mica. It abounds in Durham, Moultonborough and Sandwich, forming mountain masses in the two last mentioned towns. It is tougher than granite, but in other respects may be regarded as equal to it for a building stone.

Gneiss is economically considered merely as a kind of granite, capable of splitting more easily in one direction than another, and hence makes very long ashler stones, suitable for building, and capable of being laid up without much hammering, and with but little mortar. In building, it is best to lay the stratified surfaces against each other, on this account, and because it is less liable to undergo disintegration by the action of frost, when only the edges of the strata are exposed. Some kinds of gneiss are nearly as compact as granite, and are called granite gneiss, the rock being distinguished from granite by the parallel disposition of the plates of mica. Both the rocks are extensively employed for underpinning and building in New Hampshire.

Mica slate is composed of parallel layers of mica, intermixed with fine granular quartz, and is highly valued, when it splits true, for platforms, and is extensively used in Boston for sidewalks, having the advantage of not becoming polished or slippery. It is used in New Hampshire for well stones, steps, underpinning, stone walls, for building iron furnaces, lime kilns, &c., and the finer kinds are valuable for making scythe stones.

By its disintegration and the decomposition of its mica, it makes one of the warmest and richest soils in the State, the mica yielding an abundance of the alkalies, while the undecomposed mineral gives a suitable texture to the soil, causing it to work light, and its decomposed particles form a sufficiently retentive clay. Mica slate rocks are highly metalliferous, especially near their junction with the unstratified rocks. All the limestones, and most of the ores of metals occurring in the State, are found in this rock. The beds of talcose rock, or soapstone, are also included in it.

Talcose rock, or soapstone, is an invaluable material for various purposes. It is quarried extensively in Francestown and Orford, the former locality furnishing the largest quantity of the softest and best kind. It is used for fireplaces, boiler tops, stoves, flue stones, to preserve buildings from fire where an iron funnel passes through wood work to the chimney; also, for sizing rollers for cotton factories, no other material being equally valuable for that purpose. Its fine powder or dust is used for diminishing friction, and also for mixing with black lead in the manufacture of melting pots.

It is also an excellent material for lining stoves in which anthracite is burnt, preventing the iron from being burnt out by the fire, while it keeps up a mild and steady heat by its slow conduction. It is also wrought into sinks, watering troughs, inkstands and a variety of other useful articles. It was one of the few stones, which were wrought by the abo-

riginal inhabitants of this country, and from it they made the pots in which they boiled their food or heated water. Sometimes they used it in the place of chlorite, which they generally preferred for smoking pipes. They do not appear to have wrought any quarries, but depended on the loose stones found in the soil for their supply.

In 1794, Mr. Daniel Fuller of Francestown accidentally discovered the most valuable quarry of soapstone, that has yet been found in this country, and the quarry has furnished the softest kind of stone since 1802, when it was first wrought. (See page 86 of this report.)

The soapstone is quarried by cutting or morticing away the ends of the block, and then sawing it off with a crosscut saw and splitting up the block from its base; by this method good sound stone is got out with little waste, an important consideration, as the stone is very valuable, and its extent is limited. The usual size of the blocks is 6 feet by 3, and 7 feet by 5, but smaller ones are also valuable. It is estimated that twelve cubic feet of this stone weigh a ton. It costs from seven to ten dollars a ton to quarry the stone. About 250 tons are quarried and sold per annum, when the work is carried on extensively, but since there is but a limited supply, the owner prefers to avoid glutting the market and keeps the price high. It now sells from $3 to $3.50 per cubic foot, or from $36 to $42 per ton, in Boston. The cost of transportation from the quarry to that city is $7.20 per ton. It is carried by teams to Nashua, and from thence is sent to Charlestown by the Concord and Boston railroad. The distance from Francestown to Boston is 60 miles.

The sizing rollers are manufactured from this stone in Boston, and are 4 1-2 feet long and from 5 to 6 inches in diameter.

This stone, on account of its softness and freedom from grit, is preferred to that obtained from other places, and always commands the highest price. It is becoming more and more difficult to obtain, on account of the quarry having been worked below the natural drainage, and a steam engine and pumps will hereafter be required to free the opening from water. When this is effected, it is probable that the quarry may be wrought to any depth, for if the rock is of igneous origin, as it is supposed to be, there is no danger of its running out at greater depths.

An imperfectly stratified kind of talcose rock is also wrought in Orford for soapstone, and answers for most purposes in place of the more perfect variety from Francestown. (See page 63 of this report.)

If sawed parallel with the plane of stratification, it is strong, but is weak when sawed in an opposite direction.

Soapstone is also found in Richmond, on the estate of Mr. Lorenzo Harris, (see page 123 of this report,) but is not so soft and pure as that of Francestown. It contains occasionally crystals of iron pyrites and of anthophyllite, which render it hard to saw into slabs.

For many purposes it will prove valuable. It withstands the action of fire, and answers very well for fireplaces, forges and stoves. The bed is quite extensive, and will probably be wrought by its present owners.

A compact, tough, but rather hard kind of soapstone, is found in Warner, on the estate of Mr. Charles Davis, and is of value to the people residing in the vicinity, though it

does not appear to be soft enough to sell advantageously at a distant market. It is fully described on page 130–1 of this report.

In Haverhill a bed of soapstone is included between strata of mica slate, and will furnish blocks containing 3 or 4 cubic yards. It has never been quarried, and its quality on the surface is not of the best, it being rather hard to saw. It is pure enough for many useful purposes, and may be wrought without difficulty, the natural drainage of the place being to the depth of 40 or 50 feet. The bed runs N. 10° W., S. 10° E. and dips to the E. 60°. This locality was examined by my assistants in company with Hon. John Page.

The specimens which they obtained, were brought to me for examination, and the stone was regarded as suitable for fireplaces and for lining stoves; it is also a good material for the construction of limekilns, and occurring near a large bed of excellent limestone, may be used for that purpose.

It will probably answer for the construction of furnaces for smelting and remelting iron, and will be valuable when the Piermont iron mines are wrought.

Soapstone occurs in large boulders and erratic blocks in Pelham, N. H. and in Dracut, Mass. One which I examined in the latter town, is 27 feet in diameter: it was found on the land of Mr. John P. Cutter, on the west side of the road, on a hill 4½ miles from the Lowell railroad. A line of erratic blocks of this stone occurs on the surface, and in a north and south direction, and they are apparently drifted rocks, but we do not know from whence they came, no rocks of the kind being known north of this locality. If any bed of it exists in that direction, in place, it must be covered with soil, so as to have escaped observation. It does not seem at all probable that the parent bed can be far to the northward, since the blocks are so large and numerous.

Indian relics made of this stone are ploughed up in Dracut, and Mr. John P. Cutter has a bowl which he dug up 40 or 50 years ago, that appears to have been wrought by the aborigines anterior to their possessing tools of iron. It was evidently ground out by means of a round stone with sand and water, and its outside was rubbed down in the same manner.

Although the Dracut soapstone is hard, still it is of some use for fireplaces and forges, and the large boulders above mentioned will furnish a considerable supply. It is not improbable that the original bed will be found not far to the northward, and it should be sought for in Pelham, Windham and Londonderry.

Argillaceous slate is found on the borders of the Connecticut river on the western, and at Portsmouth, Somersworth and Bartlett, on the eastern side of the State. It is occasionally sufficiently soft and compact for gravestones, platforms and flagging stones, but is rarely sufficiently fissile, sound and even for roofing slate, the fissile variety occurring somewhat farther to the eastward and westward, than the borders of New Hampshire, as at Guilford, Vt., a locality near enough to New Hampshire to be of importance to her citizens, (see pages 128–9,) and on the Kennebec river at Moscow, Me., (see Third Annual Report on the Geology of Maine.)

The compact variety of argillaceous slate has been wrought for tombstones in the northwest corner of Unity, in Claremont, at Cornish Flat, Dalton and a few other places in a more limited manner. It may be obtained from the south side of Pequaquet mountain, in Bartlett, and probably in the mountains of Hinsdale, on the borders of the Con-

necticut river. I have seen slate rocks in numerous places along the borders of the State, but it is impossible to judge of their working quality, unless they are quarried to a depth beyond the influence of frost, where they will show their degrees of soundness and evenness of grain.

If slates contain any iron pyrites, they are worthless; for on exposure to air and water the pyrites becomes oxidated, and the sulphuric acid formed rapidly attacks the alumina of the slate, forms sulphate of alumina and causes the slate rapidly to disintegrate or crumble to pieces.

A good roofing slate should split perfectly even, and should be generally from 1-30 to 1-36th of a foot in thickness, and on being suspended and struck with the knuckles, should ring like a piece of sound earthern ware. It should be sufficiently soft to admit of being easily cut with the slater's knife, and to have holes punched in it without breaking at the corners. The slates should be not less than 15 inches long, by 10 or 12 inches wide.

With these directions any one may judge of the qualities of roofing slates, and decide whether a locality is worth working.

Writing slates should be sufficiently soft to admit of being planed even, and to allow a distinct mark to be made with a soft slate pencil, but not so soft as to be scratched. This will be obvious to every one. Tombstone slate must not be too fissile, or it will be shivered to pieces by the action of freezing water. It should not contain any iron pyrites, and ought to be soft enough to admit of the easy sculpture of letters and ornamental designs. If it does not possess all these qualities, it is worthless. Recently the marbles of Vermont and of Stockbridge, Mass., have, in a measure, superseded the slate tombstones, and are generally preferred. They are furnished in great quantities by the Vermont marble quarrymen, the stone being very abundant and cheap in that State.

Slate, when highly charged with iron pyrites, is used for making alum, but I have seen but few localities where it could be profitably manufactured, and none in New Hampshire that are worthy of trial.

Slate rocks, by decomposition and disentegration, form a tough blue clay, suitable for brick making and useful as an ingredient in soils, retaining moisture and the manures. Clay is useful for improving sandy soils, and may be applied in its raw or half burnt state with advantage.

Granular Quartz, is composed of small rounded or angular grains of quartz crystals, aggregated like loaf sugar, and capable of being easily separated by the crushing wheel or by the stones of an ordinary grist mill. It is used for sand paper, glass making and a variety of other purposes treated off further on. When used for building furnaces, limekilns or houses, it should not be too friable, but should be sufficiently firm to hammer into shape, if required. It occurs in Acworth, on William's hill, in large quantities; also in Unity, (p. 60,) Winchester, (p. 125,) and some other places mentioned in the preceding sections of this report. Milk quartz abounds in Lyndeborough, Temple, (p. 122-3,) Keene, (p. 87,) and many other towns in the State; the above mentioned being the most important localities. Granular quartz may be used for building, when the grains are sufficiently attached to each other to prevent the frost from acting upon it, since it is as firm as sandstone, while it looks like white marble. It has not yet been used for that purpose, few

localities out of the State of New Hampshire furnishing an adequate supply. Its most important application is the manufacture of glass. For fine snow white ceilings it will answer admirably, if used in the place of sand, with the best kind of lime.

Calciferous Granular Quartz.

A remarkable rock, consisting of a mixture of white granular quartz, silicate and carbonate of lime, is found on the estate of Mr. Charles Scott of Lyme. (See p. 112.)

By chemical analysis of 100 grains of this rock, it was found to contain—

Silica,	80.40
Lime,	14.72
Magnesia	1.12
Oxide of iron,	0.88
Carbonic acid,	2.88
	100.00

From its chemical composition it was supposed to be a good article for the manufacture of glass, and on adding a suitable proportion of the alkalies, potash and soda, a very good greenish window glass was made, by fusion in a porcelain crucible. The lime is twice as much as it should be in making the best kind of window glass. It will therefore be necessary to add another proportion of silex in the state of granular quartz, or to dissolve out a portion of the lime.

In the town of Unity, granular quartz is very abundant and pure, and may also be used for making glass. At present it is ground into sand for sand paper, and sold to the manufacturers of Vermont. Mr. Daniel McClure owns the locality, and grinds the quartz.

He prepares three sizes, by means of a bolting machine, which sizes correspond to sand papers Nos. 1, 2 and 3.

A fine polishing powder, equal to emery for all ordinary uses in polishing metals, &c., is also put up in papers of one pound each, and sold for 12 cents each.

The same kind of granular quartz which serves for the manufacture of sand paper, will also answer for the manufacture of rifles for sharpening scythes. It is also a good substance for mixing with paint, to encrust the pillars of public buildings, so as to prevent injury from the knives of idlers.

The finest powdered quartz has also been successfully mixed with white lead in large quantities, and it is said to answer the purpose better than barytes.

I have used Mr. McClure's granular quartz for mixing with fireclay, in the manufacture of crucibles and muffles, which are employed in my laboratory, and find it to be of excellent quality for that purpose.

It may also be used by dentists, who require an addition of quartz for the formation of mineral teeth from felspar. It will also make an excellent body for firebrick, when mixed with refractory clay. Where a perfectly white stucco or plastering is wanted for ceilings, it is an excellent article for mixing with the lime, in the place of sand.

It has a very sharp grit, and is one of the best materials for sawing and grinding marble.

When fused with a large proportion of potash or soda, it forms a glass, soluble in hot water, which, if spread upon wood work, will effectually prevent its taking fire.

I have mentioned some of the various uses to which this mineral may be applied. It is not improbable there may be numerous other arts in which it may be used advantgeously. It must be remembered that only a few years have passed, since granular quartz was ranked among the useless minerals, and we may be led to a more full belief in the principle that "*nothing is made in vain*," although we may not at the moment discover how it may be employed.

Granular quartz quarried in masses, is worth on the spot $1.50 per ton—ground and not bolted, $5 per ton—bolted $20 per ton. It grinds very easily in a common grist mill with granite stones, but bolts slowly, on account of its great weight; hence the increased cost of the bolted and assorted powders.

Limestones.

Among the inexhaustible limestone beds of New Hampshire, we may rank those of Haverhill, Lisbon and Lyme. The former is situated, as described in a former section, near the base of Black mountain, in the town of Haverhill, about six miles northeast from the village.

This bed of limestone is of incalculable importance to the people of New Hampshire, and will save an immense sum from expenditure for foreign lime. The present known limits of the bed are evidently far short of its real extent, but enough is already exposed to furnish a constant supply for ages. The whole width cannot be less than 400 feet, and its length, as at present seen, is 800 feet; but it reaches in a linear direction, to an unknown extent, such wide beds rarely narrowing, when traced even for the distance of miles. The natural drainage is such that it is easy to quarry the rock to the depth of 25 or 30 feet, without any aid from pumps or syphons, so that the situation in this respect is favorable for working.

The country around is thickly wooded, so that an unlimited supply of fuel is readily commanded. I understand that this bed of limestone has been purchased by Hon. John Page of Haverhill, and is wrought by Mr. Gannet. The proprietor of the limestone owns 900 acres of woodland on the hill-side adjacent to the quarries, and he estimates the cost of wood fuel only at 50 cents per cord. His first kilns were badly constructed, and required from 18 to 20 cords of wood to burn a kiln of 60 tierces of lime; but the new ones, built according to the plan described to him, will require but 8 or 10 cords of wood to produce the same result. He makes two different kinds of lime, the first quality selling at $1.50 per tierce, the second at $1.25. Each tierce contains six bushels.

When it is considered that the principal expense of making lime consists in the cost of fuel, and that wood sells for $3 per cord in Thomaston, Me, and $5 per cord in Smithfield, Rhode Island, it will be perceived that the business of making lime at Haverhill, even at the low price above stated, cannot fail to be profitable, and that great advantages will accrue to the purchaser from the cheapness of the article. Heretofore the lime used upon the borders of the Connecticut river, in New Hampshire, was brought exclusively from

Vermont, and immense sums of money must have been expended in its purchase. So long as it could be obtained at a lower price from the Vermont kilns, it was natural to depend upon them; but now Haverhill lime is destined to supply that region.

Chemical analysis of the first quality Haverhill Limestone.

This limestone is granular, crystaline and white, having no visible foreign matter mixed with it. 100 grains submitted to chemical analysis, yielded—

Carbonate of lime, - -	99.3
Mica and quartz, - - -	0.5
Carbonate of manganese, - -	0.2
	100.0

or it contains 55.729 per cent. of pure lime, by weight.

The 2d quality limestone contains bluish colored streaks, like that from Thomaston, Maine, and is granular or crystaline, but more solid than the 1st quality rock. 100 grains analyzed, yielded—

Carbonate of lime, - -	90.66
Mica and silex, - -	3.80
Carbonates of iron and manganese,	5.54
	100.00

or it contains 51.03 per cent. of lime.

Lime of Lisbon.

Limestone likewise abounds in the town of Lisbon, near the southwest extremity of Mink pond, and is quarried and burnt for lime in several places.

The principal quarries which are wrought, belong to Messrs. Orren Bronson, Thomas Priest, David Priest and Uriah Oakes. The limestone is a crystaline or coarse granular variety, marked with blue and grey stripes, indicating the original lines of stratification. It is occasionally mixed with particles of mica, and a little quartz. The bed as formerly described, is contained between strata of mica slate, and pursues a N. E. and S. W. direction with the line of strike of the strata.

Mr. Thomas Priest's quarry has been most extensively wrought, and the excavation measures 300 feet in length. The breadth of the bed is 13 feet. Drainage is easily practicable to the depth of more than 60 feet.

Fair specimens of this limestone were taken for chemical analysis, and its composition is as follows:

Carbonate of lime, - -	90.8
Mica and quartz, - -	8.2
Carbonate of iron and manganese,	1.0
	100.0

M. B. W.

David Priest's quarry is situated one and a half miles northeastward from the above mentioned.

A specimen of this rock, analyzed in my laboratory, yielded in 100 grains,

Carbonate of lime, - -	81.6
Mica and quartz, - -	15.6
Carbonate of iron and manganese,	2.8
	100.0

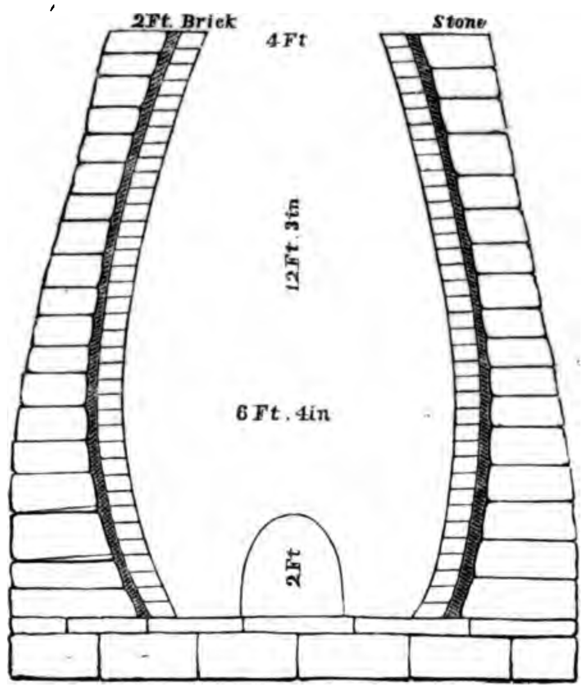
J. D. W.

It contains 45.59 per cent. of lime.

The lime is in good repute, and is employed to some extent in the vicinity. Mr. Ward Priest says he has used it very successfully in agriculture, as a top dressing.

I obtained at the kiln the following statistical information from Mr. Priest.

He burns from four to six kilns of lime per annum, when not engaged in his farming operations. The kiln holds about 35 tierces of lime. Each tierce holds six bushels. One which I measured, was two feet four inches high; one foot nine inches head diameter; bilges, to one foot ten inches. The cost of the casks is 42 cents each.



Limekiln of Lisbon.

The kiln is egg-shaped, and measures twelve feet three inches in height, four feet in diameter at the top, six feet four inches in diameter at the boshes, (a little below the centre.) Arch for fuel, two feet high. The walls of the kiln are two feet thick, and are made of mica slate lined with common bricks. It cost $150.

He says that the common bricks soon glaze over on the surface, and withstand the heat sufficiently well. Four days and three nights are required for burning a kiln of lime, and ten cords of wood are consumed in the operation. From two to three men are employed. The cost of wood, cut, split and delivered at the kiln, is $1 per cord. The lime sells for $2 per tierce at the kiln.

Limestone near Franconia Furnace.

Mr. Oakes' quarry is situated two miles west from Franconia furnace, and is wrought to some extent for lime. This kiln is built like the one before described, but is of larger dimensions, containing 100 tierces of lime. It is built of the common rocks found in the vicinity, and is lined with mica slate. The walls are from two to three feet in thickness, and the lining is one foot thick. The cost of this kiln was $100.

He sells his lime for $1.50 per tierce, without the cask, and for $2 when packed in them.

Wood, cut and delivered at the kiln, costs $1 per cord. Fifteen cords of wood are required to burn a kiln of lime. Burning requires four days and three nights. Three men are employed in attendance on the kiln.

Estimate of cost and profits on one kiln of lime.

Cost of quarrying and hauling to kiln,	$41
Breaking and filling in, - -	6
Filling out, - - - - -	10
15 cords of wood, - - - -	15
Labor, - - - - -	7
100 casks at 42 cents, - - -	42
Interest and incidental expenses, say -	5
Cost, - - - - -	$146
100 casks of lime sell for - -	$200
Profit on one kiln of lime.	$54

By chemical analysis of a specimen of this limestone, 100 grains contains,

Carbonate of lime, - - -	78
Silica and mica, - - -	20
Carbonate of iron, - - - -	2
	100

M. B. W.

Hence it contains 43.9 per cent. of lime.

This limestone is situated favorably for supplying the Franconia furnace with a flux to be used in smelting their iron ores, and they obtain it for that purpose.

Mr. Oakes has employed his lime successfully in agriculture, as a top dressing, in the proportion of one tierce to the acre. He has mixed it with compost manure and applied it to his potato crop, which, he says, appears unusually flourishing.

Limestone of Lyme.

Chemical analysis of specimens of limestone from the town of Lyme.

The light colored crystaline limestone of Lime yielded in 100 grains—

Carbonate of lime, - - -	71.70
Siliceous matter, - - -	25.70

Carbonate of iron and manganese,	2.60
Carbonate of magnesia traces,	
	100.00

It contains 40.35 per cent. of lime.

Analysis of dark colored limestone from Lyme. 100 grains, yielded—

Carbonate of lime,	83.6
Silica and mica,	15.0
Carbon,	0.2
Carbonate of iron,	1.2
	100.0

It contains 47.04 per cent of lime.

100 grains limestone of Orford, yielded—

Silica,	6.4
Protoxide of iron and alumina,	4
Carbonate of lime,	90.
	100.4
Excess, filter ashes,	.4
	100.0

It contains 50.66 per cent. of lime.

100 grains limestone of Amherst, yielded—

Silica,	21.
Iron and alumina,	2.4
Carbonate of lime,	75.2
	98.6
Loss,	1.4
	100.0

It contains 42.32 per cent. of lime.

A poorer variety of limestone occurs in Claremont, but it is only useful for agricultural purposes, and must be burnt at a very carefully regulated red heat, otherwise it will form a slag.

100 grs. white crystaline limestone, Warner, yielded—

Siliceous matter,	33.0
Iron, a trace,	
Carbonate of lime,	56.4
Magnesia,	10.8
	100.2

It contains 31.74 per cent. lime.

100 grains limestone, Warner, light grey siliceous, yielded—

Siliceous matter,	72.0
Peroxide iron,	2.4
Carbonate lime,	10.0
Carbonate magnesia,	13.0
Alumina,	8
	98.2

It contains 5.62 per cent. lime, and is not so good as it was supposed to be.

Limestone from Judge Jackson, Cornish. It is of a dark blue color, with white veins. On analysis, 100 grains yielded—

Siliceous matter,	31.0
Peroxide iron,	6.8
Carbonate lime	58.6
Carbonate magnesia,	1.6
Alumina,	1.0
	99.0

It contains 32.98 per cent. lime.

Limestone from Col. White's quarry, Lunenburg, Vt., 2d bed—color of the stone, greyish blue. 100 grains yielded—

Siliceous matter,	40.6
Carbonate lime and magnesia,	47.6
Peroxide iron and alumina,	11.0
	99.2
Loss,	.8
	100.0

100 grains Plainfield limestone yielded by analysis—

Siliceous matter,	25.0
Peroxide iron,	2.8
Carbonate of lime,	23.8
Carbonate magnesia,	46.6
	98.2

It contains 13.39 per cent. lime.

Limestone from Johnson's quarry, Cornish—color, light grey—micaceous. 100 grains yielded—

Siliceous matter,	59.6
Peroxide iron,	3.4
Carbonate of lime,	22.6
Carbonate magnesia,	13.8
Alumina,	4
	99.8

It contains 12.72 per cent. of lime.

NOVACULITE, or OIL STONE, is found abundantly in the town of Littleton, on the estate of Mr. John Palmer, and is quarried and wrought by Mr. O. R. Fyler of Bradford, Vt., who has purchased the right for ten years. (See page 109 for a description of the quarry.) The oil stones are ground into proper forms, and sold for 25 cents per lb., and are in good repute. The stone is a greenish and blue compact slate, having a fine siliceous grit. The goodness of an oil stone depends on its wearing away evenly, so as not to glaze, and always to present new surfaces of fine siliceous particles which cut away the steel. The quarry above mentioned furnishes several different kinds, some of which are very good. Workmen differ not only in their tastes as to oil stones, but there are also different uses for which they are employed, some requiring a fine stone which does not cut fast, and others one which takes hold of the steel and cuts more rapidly. For fine instruments the closest grained stone is preferred, while for carpenter's tools one which is softer and has a coarser grit, is required. When it is desirable to slit an oil stone in two, it is effected by means of a piece of sheet copper fixed in a frame, and charged with emery and water. The particles of emery being imbedded in the copper, cut the stone rapidily, so that it may soon be divided. A plate of soft iron, or of lead, will answer in the place of copper, but the latter is preferable as possessing the most convenient degree of stiffness and softness.

FELSPAR is one of the regular components of granite, and abounds in New Hampshire in all its varieties. The largely crystalized granite veins present the finest specimens, and from them it is procured, while blasting out the large plates or crystals of mica. It is found in every town in the State, but can be most readily obtained from the mica quarries of Alstead, Grafton, Springfield and Wilmot; since it is generally thrown aside when quarrying for mica. Crystals, ten inches long and eight inches in diameter, are not uncommon, but they rarely have all their planes well defined, so as to interest mineralogists. All the New Hampshire felspars that I have examined, contain both potash and soda, the latter alkali more frequently predominating. (See page 34 *et seq.*)

The following is an analysis of the albite or white felspar of Alstead.

Silica, - - - -	70.84
Alumina, - - - -	21.20
Soda, lime and oxide of iron, - -	7.97
	100.00 J. D. W.

The principal alkali being soda, my assistant did not separate the small proportion of potash which probably exists in it.

This felspar answers very well for making porcelain and mineral teeth, and has been used by Boston dentists for that purpose.

The Grafton and Wilmot felspars have also been tried at my request, by Dr. N. C. Keep and other dentists, and have been found to make the finest mineral teeth. This proves their capability of being used for making the most beautiful China ware or porcelain, and if good workmen, familiar with the business, would undertake the manufacture of this ware in New Hampshire, they would find an abundance of good materials and wood for fuel at low cost. When we are more advanced in the arts, I have no doubt that porcelain

works will be eerectd in New Hampshire, near some of the extensive veins of good felspar; and it appears to me that the business ought to be profitable, considering the great difference in the price of wood fuel in Europe and this country. Felspar is also used for lining iron sauce pans and other culinary utensils, where freedom from iron rust is an object; and our market is at present supplied with this ware from Germany.

When felspar decomposes, it forms a fine clay, which is used for porcelain, under the names of kaolin and lithomage. Pulverized felspar is the petuntze of the Chinese. Carbonic acid of the soil, and the acids formed by the decomposition of vegetable matter, act upon felspar and abstract its alkali, which is then taken up by the rootlets of plants, and enters into their composition, serving at the same time as a solvent vehicle, by which the organic acids are in part introduced into the sap vessels of plants. On burning any vegetable substance, we obtain the alkali, this being the cheapest method of extracting it.

Scythe stones are generally made of a fine soft mica slate, consisting of mica and granular quartz. When the stone is split out from the quarry into convenient sized thin sheets, it is broken into pieces about three or four inches wide and ten inches long, which are roughly hewn with a hatchet, and then ground on a grindstone sprinkled with siliceous sand. They are rounded on the sides, edges and ends, and when finished, are about nine inches long, two inches wide, and three-fourths of an inch thick. Their sharpening qualities, like those of the oil stone, are dependent on the renewed surface of the siliceous particles, the mica wearing away as they are used. They are manufactured from the mica slate near the Oliverian stream in Haverhill, and are known by the name of Oliverian stones. I do not know the extent of the business, as the workmen were not on the ground when I was there.

In Rhode Island, scythe stones are extensively manufactured at Woonsocket, and the following statistics, extracted from my Report on the Geological and Agricultural Survey of Rhode Island, will probably apply to the business as carried on at Haverhill, and if not, any of the data which do not apply, may be altered accordingly.

Right of quarrying,	5	cents per dozen—(probably nothing in N. H.)
Cost of quarrying, -	8	"
Labor, - - -	10	"
Grinding, - - -	6	"
Sand for grinding, -	1 1-2	"
Boxing up for market, -	9	"
Carting, - - -	3-4	"
Transportation to New York,	2	"
Cost per dozen,	42 1-4	"
They sell for,	65	"
Profit, per dozen,	22 3-4	" on the best stones.

One man cuts ten dozen per day, after the stone is quarried. About ten thousand dozen are made and sold annually, at the Woonsocket quarry. The business will afford occupation when there is but little else to be done, and hence a quarry of good scythe stones is valuable.

The prices vary, however, from 28 to 65 cents; the mean of which is 46 1-2, and if we deduct the cost from this, there will remain 4 1-2 cents profit per dozen.

Granular quartz glued to a strip of wood, makes a very good instrument for sharpening a scythe, and is much sharper than sand, which is more commonly used for the purpose. Emery may be employed in the same way, and the grain is much harder than quartz, since the particles are granular corundum or sapphire.

Mica is obtained in large quantities in the towns of Alstead and Grafton, where regular quarries are wrought in extracting it from the coarse granite rocks.

The Alstead quarry is leased by Mr. James Bowers of Acworth, who pursues the business in a profitable manner, and sells from $800 to $1000 worth per season, at the rate of from two to three dollars a pound. He supplies the Boston market with a large quantity of this useful mineral. (See p. 59.)

The Grafton quarry is wrought by persons resident in Boston, and their principal market is New York. They quarry and sell about $1500 worth per annnm, and obtain from $2 to $3 per pound for the trimmed plates, suitable for use. The rough irregular plates are sold at prices varying from $1 to $2 per pound. (See p. 115.)

It is found also in Wilmot, in plates, generally about six inches in diameter, and of a regular hexagonal form. (See p. 133.) Also in Springfield, at the Beryl hill. (See p. 134.) But neither of these localities furnish such splendid specimens as the Glass hill of Grafton, where the mineral has been extensively quarried by Messrs. Ruggles of Boston.

Mica is used for a variety of purposes, and will probably be applied in many new ways, as it becomes better known and cheaper. It is principally used at present for lanterns, stove windows, backs for the cards of mariners' compasses, to which it is especially adapted, as it is not liable to warp or to expand and contract sensibly by heat and cold, and is very light.

In Russia it is used for windows, in the place of glass, and is said to have been employed on board ships of war, since it is not liable to break by the concussion produced on firing heavy ordnance.

It makes excellent chimneys to chemical lamps, and I have used it for that purpose for many years. In making a lamp chimney, the mica is rolled up and slipped into a frame made of two rings of sheet copper, connected by two strips of that metal, and the ends which project beyond the rings, are clamped down over the mica, and keep it in place. It is the only proper material for the chimney of an alcohol blast lamp, such as is used in my laboratory. It is also useful in the laboratory in the place of paper, for supporting substances in the balance during the operation of weighing, two equal plates being prepared, one for each pan of the balance. It admits of being bent up, so that the powder weighed out, may be poured into a flask; and since it is not hygrometric, it is much better than paper for this use. Small clippings of mica are used with gypsum in the manufacture of safes, this mixture being an imperfect conductor of heat, and answering the same purpose as asbestus in binding the gypsum together. For description of this mineral and analysis, see page 36 *et seq.*

Plants obtain a large proportion of their alkaline ingredients from decomposed mica, the

mineral containing from ten to twelve per cent of potash and soda, besides a considerable proportion of magnesia and lime.

Hearth stones for furnaces are composed of granular quartz, containing a little mica or talc, the two last mentioned ingredients acting as binders to the particles of quartz, so as to prevent its cracking. The mica melts and unites firmly the grains of quartz, while there is not enough of it present to flux the whole rock. Talc is infusible and remains unaltered in the stone. It is silvery white, or pale green, and has a soap-like feel when rubbed on the fingers.

Fluor spar is a chemical combination of fluorine and calcium, the metallic base of lime consisting of 48.13 per cent. fluorine and 51.87 per cent. of calcium. It crystalizes in the primary rocks of New Hampshire always in its primary form, the regular octahedron, and is most frequently of an apple green color, or transparent and colorless, but rarely of a blue or purple tint. It cleaves readily, parallel to its primary planes and those of a regular tetrahedron and acute rhombohedron, which last may again be reduced by cleavage into one octahedron and two tetrahedra.

From this substance that powerful element, fluorine, is disengaged by the action of sulphuric acid and heat; and as it passes off in the state of gas, has the property of dissolving quartz and of taking that substance from all of its combinations, and converting them into a gas, which, if passed through water, will deposit the silex as a hydrate of silica, and be itself converted into a solution of fluo-hydric acid.

It is used for etching on glass and on agate, which it attacks instantly. In the metallurgic art it is employed as a flux in reducing some metalliferous ores, and hence its name was derived from the Latin word, signifying its flowing or melting property. It is found in Westmoreland, in veins of considerable magnitude, and crystals of several pounds' weight have occasionally been obtained, (p. 56.) It occurs also in Jackson, at the tin mines, and half a mile south of that spot, in the hill side, (p. 141.) It was discovered some years since near the house of Mr. Abel Crawford, and in the slide at the Willey house, in the pass of the White Mountains.

There is a moderate demand for this mineral in druggists' shops, and it sells for 25 cents per lb. It may be used for removing silica from plumbago and from vegetable fibre; also for etching on agate or glass.

Sulphate of barytes is a combinationof sulphuric acid and baryta, and occurs naturally in crystals and massive. Its name denotes its great weight, it being heavier than other chemical salts. It is found in Piermont, in bunches and nests, in the specular iron ore of Cross' hill. It is composed of—

Sulphuric acid, - - -	34.37
Baryta, - - - - -	65.63
	100.00

This mineral is employed elsewhere largely to mix with white lead, and when not used too freely, does not materially injure its quality. The admixture of large proportions of it, without notifying the purchaser, is a fraud, since the sulphate of barytes does not cost one quarter of the price of carbonate of lead.

Chemists prepare other barytic salts by decomposing the sulphate of baryta, but they use so small a quantity that there is but little demand for it. It has been used in France in making cupels for separation of lead and silver.

Precious Stones.

Beryl is found in Grafton, Orange and Danbury, of the utmost purity, and is either transparent and colorless, or pale blue or green. Its crystals are regular six sided prisms, with plane terminations, or having a series of little facets on the terminal edges and solid angles.

The best crystals are found loose in the soil, and they appear to have been improved in their transparency by the long continued and combined action of the organic matters of the soil and of water. Some handsome crystals are found in the quartz veins, but they never possess so fine a water as those dug up from the soil. Some small crystals which I found in Grafton, I have had cut by an experienced lapidary, who pronounced them to be the finest he had ever seen. They were nearly colorless, and had a degree of transparency and brilliancy of lustre, which might easily cause them to be mistaken for diamond.

Beryls are quite abundant in New Hampshire, but they too generally crystalize on so large a scale as to destroy their value for jewelry. Some of the Acworth crystals weigh more than 200 pounds. I have two crystals in my cabinet, which are 18 inches long by a foot in diameter. They were blasted out of the granular quartz of Acworth, when the quarry was first opened by Mr. Bowers, a number of years ago. At present it is impossible to obtain any more without great expense in blasting away the cliff of quartz rock, under which they may be seen projecting from and included in the quartz and granite.

The following is a chemical analysis of the clear green beryl of Acworth—

Silica, - - - -	68.35	
Alumina, - - - -	17.60	
Glucina, - - - -	14.00	
Chromic oxide traces, oxide iron and loss,	0.05	
	100.00	M. B. W.

Formula, (A. G.) Si^3 —Beudant.

Emerald and beryl are identical, excepting the occurrence of a larger proportion of chromic oxide, which gives the fine green color to the emerald.

Emerald of Peru contains, according to Klaproth—

Silica, - - - -	68.50
Alumina, - - - -	15.75
Glucina, - - - -	12.50
Chromic oxide, - - -	0.30
Oxide of iron, - - -	1.00

Hence it will come under the same formula with beryl.

Garnet. This mineral occurs in profusion in the primary crystaline rocks, and in chlorite veins and nodules. There are three species found in New Hampshire, viz: almandine, spessartine and cinnamon stone.

The almandine crystalizes in rhombic dodecahedra, rarely replaced on the edges or angles by tangent planes or narrow facets. This mineral is readily distinguished by its form, color and fusibility before the blowpipe. It is composed of—

Silica,	36.0	
Alumina,	22.0	
Protoxide iron,	36.8	
Lime,	3.0	
	97.8	*Vauquelin.*

Its mineralogical formula is A. Si+f. Si.

The best crystals are found in Haverhill, and occur near the house of Mr. Roswell Wilmot, in chlorite, the crystals being quite perfect, and an inch or more in diameter.

Their colors are rather too dull for jewelry.

Small crystals of almandine are exceedingly abundant in the hornblende slate of Hanover, and occasionally finely colored crystals, suitable for ornament, may be obtained. They are not highly valued unless their color is very rich.

Occasionally, fine colored fragments of large garnets are obtained on breaking up granite rocks, but the best crystals are more frequently ploughed up from the soil, where they were deposited during the slow disintegration of the rock containing them.

Spessartine, or manganesian garnet, is often of a very fine color, but is very liable to be spoiled for the lapidary's wheel by numerous cracks or natural joints in the crystal. The form which this species most commonly assumes, is that of a trapezohedron, consisting of 24 equal trapezoidal planes. It is composed of—

Silica,	35.83
Alumina,	18.06
Protoxide manganese,	30.96
Protoxide iron,	14.93
Water,	0.66
	100.44

The formula for this species is A. Si+Mn Si.

A most abundant supply of perfect crystals of this mineral may be obtained in a few hours, by breaking up the mica slate rocks of Springfield, N. H. They occur in such profusion that the mica serves only to connect them together, so that on breaking the rock with the hands they fall out and are found to be perfect crystals. They are of very uniform sizes, about as large as a filbert. Rarely two crystals are united together. They possess a good color, but none of them appeared sufficiently rich for jewelry, and I have not had them cut so as to try their effect. To the mineralogist and crystalographer, they are interesting specimens.

Cinnamon stone differs from the other garnets, by containing a larger proportion of lime, so that it approximates to grossularia.

It occurs at Amherst, N. H., at the lime quarry, near the Bedford town line. The occurrence of this mineral with egeran and pyroxene, at the junction of this limestone with the primary rocks, sufficiently indicates their igneous origin; since in this case a series of

silicates containing lime, (exactly such as we know to have resulted from igneous agency elsewhere,) has been formed by the combination of two different rocks.

Cinnamon stone commonly is of a pale wine red, or yellow, and resembles hyacinth or zircon in appearance.

At this locality it is not highly charged with coloring oxides, and is of a very pale cinnamon brown hue, and not suitable for jewelry, although some of the specimens are ornamental to the cabinet. None but the superficial rocks have yet been opened, and it is not improbable that other more rich specimens may yet remain to be discovered.

Amethystine quartz. This mineral, although not very rare, is generally admired for its rich purple or violet colors. It is quartz crystal colored by oxides of iron and manganese.

The finest colored specimens are found loose in the branches of the Saco river, where it takes its rise in the White Mountains. Their original bed is unknown.

Large crystals of amethyst were found in Amherst, in the soil, and there is a fine specimen of it, 8 inches long, in the State collection of minerals.

Quartz crystals, often suitable for jewelry, are found in the granite of New Hampshire, but the crystals found loose in the soil are always clearer, and are less defaced than those broken from the rock. Smoky quartz occurs in veins, and, occasionally, solid masses may be obtained which are suitable for the lapidary. The best locality for this variety is in the town of Wilmot, at the beryl locality.

Iolite is a fine delicate blue colored stone, having a violet tint when viewed in one direction, and blue in another. It is known to the French jewellers as *saphir d'eau.*

There are two localities of this mineral, viz: Richmond and Unity; the former being the best locality for the deep blue colored stone, which is identical with that of Bodenmais.

Good specimens, suitable for jewelry, will only be obtained by blasting into the rock beyond the reach of atmospheric influences. From the color of some of the pieces we obtained, there can be no doubt that fine stones may be obtained there.

Iolite is composed, according to my analysis, of—

	Haddam, Ct.	Unity, N. H.	Richmond, N. H.
Silica,	48.35	48.15	48.00
Alumina,	32.50	32.50	35.00
Magnesia,	10.	10.14	10.
Protoxide of iron,	6.	7.92	6.
Protoxide of manganese,	.10	.28	1.
Water,	3.10	.50	
	100.05	99.49	100.00

Formula, $3\ Al.\ S.+Mg^2$.

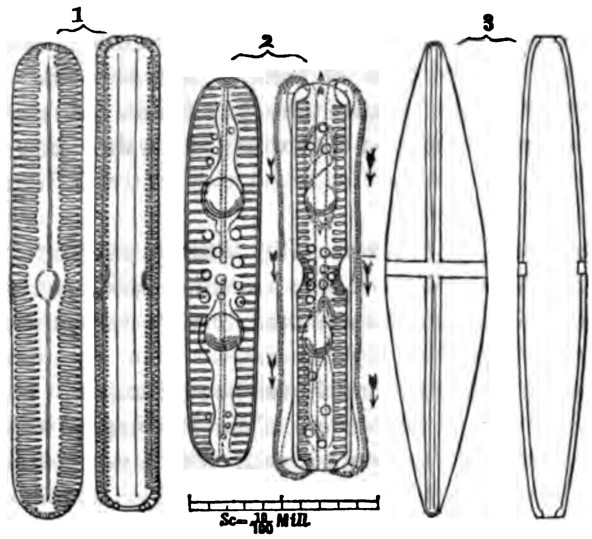
Analysis of chlorophyllite from Unity—

Silica,	45.20
Alumina,	27.60
Magnesia,	9.60
Protoxide of iron,	8.24

Protoxide of manganese, - -	4.08
Water, - - - - -	3.60
Trace of phosphoric acid and loss, -	1.68
	100.00

INFUSORIAL SILICA. This remarkable substance, which has occupied the scientific skill of the celebrated Count Ehrenberg, who first discovered it to consist of the siliceous shells of infusorial animalcules, is extremely abundant in New Hampshire, many bogs and ponds having a substratum of it, sometimes several feet in thickness, and extending over an area of many acres.

Specimens from many different localities in the State have been examined by the microscope, and have been found to contain the same species of animalcules, as have been described by Ehrenberg and Bailey. Among the most common forms are the following, which are copied from Prof. Bailey's microscopic delineations.



Wood cut representing forms of Infusorial shells common in the peat bogs and ponds of New Hampshire.

The chemical composition of this substance is as follows, as determined by analysis of a specimen from Hooksett.

Water, - - - - -	5.50
Vegetable matter, consisting of the organic acids of soils and lime,	6.80
Silica, - - - - -	80.00
Al. traces, - - - -	
Phosphate of lime, - - -	1.80
Phosphate of magnesia, - -	5.84
Oxide of manganese, oxide of iron and loss,	0.06
	100.00

When the organic matters are burnt out from it, and it is washed, and the finest particles are allowed to subside, and are collected and dried, it forms the polishing powder known in commerce under the name of Tripoli, an article much used by daguerreotypists in polishing their silver plates. It has been sold in Boston, in its unprepared state, for magnesia, which it closely resembles in appearance and lightness, but has none of its medicinal qualities. It is not unfrequently mistaken for calcareous marl, an error easily corrected by pouring upon it a few drops of acid, which will cause effervescence with calcareous marl, but none with this substance. Some farmers have used it in the amendment of sandy soils, the texture of which it improves by its fineness, and it imparts fertility by its organic matters and calcareous and magnesian phosphates. I have seen it bring in white clover, when spread on sandy soil, where no clover seed had been sown. I have raised good healthy plants in pots filled with it, and without any manure, and it seems to be well adapted to the growth of Indian corn, which requires a large supply of the phosphates.

The infusorial silica may be made into bricks, and burnt, and will then answer in the place of fine Bristol brick for scouring. If too fragile, a little pipe clay will bind the particles more firmly. A very light kind of firebrick may be made in this way. I have seen them made of the infusorial silica of Blue hill, Maine, and they were so light as to float like pumice stone, until saturated with water, when they sank to the bottom.

In New Hampshire, this substance is found abundantly in Grafton, Exeter, Littleton, and many other places.

Bristol Bricks are made, as I have recently learned, in South Hampton, by mixing pipe clay from Martha's Vineyard with fine moulding sand, and then baking them. I have not yet examined the sand, but understand from the examination made by Dr. H. C. Perkins of Newburyport, that it is very fine siliceous loam, or common moulding sand.

Brick and Potter's Clay is distributed over New Hampshire in a very unequal manner, being comparatively rare on the borders of the Merrimack, while it is very abundant along the whole course of the Connecticut river, where it generally contains a minute proportion of lime. It consists of the ancient alluvion of the Connecticut river and its tributary streams, which run over limestone rocks or receive the wash of calcareous districts. The greater fertility of the soil along the valley of the Connecticut river, is to be imputed to the calcareous nature of that river's ancient and modern alluvion, and to the retentive power which such a soil possesses. The following is the composition of one of the least calcareous clays of Bath, taken from a brick yard near the river.

Chemical analysis of plastic clay from Bath. 100 grains of the dry clay contain—

Water,	1.8
Vegetable matter,	3.5
Insoluble silicates,	81.2
Peroxide of iron,	6.7
Alumina,	5.0
Crenate and sulphate of lime,	1.7
Loss,	0.1
	100.0

The marls generally occur at a higher level, and belong to the deposits of a more ancient epoch, remote, perhaps, as the drift or diluvial period.

PAINTS. Among the natural deposits are those of red, yellow and brown ochre, which are but varieties of bog iron ore. All of these may undergo modifications by washing and roasting, so as to change their shade and tone of color. Yellow ochre, when burnt, becomes of the same nature as Venetian red. Some red ochres which contain organic matter, become of a deeper hue by moderate roasting. Brown ochre, thoroughly burnt, becomes red, &c.; all these changes being due to the agency of heat in modifying the organic matters, in changing the degree of moisture, or in oxidation of the iron ore. At a low temperature, not above 300° F., or below a heat that will brown paper, the water is expelled from the ochre. At a higher temperature the organic, (vegetable,) matters are charred and give a dark color. At a still more elevated temperature the coaly matter thus produced, reduces a portion of the peroxide of iron to the state of protoxide, and thus darkens the red color. Roasted at a full red heat, with free admission of air, the protoxide is again converted into the peroxide, or gains one equivalent of oxygen from the air. Any one understanding these operations, may make a variety of paints from the same bog iron ore. The paint called spruce yellow, is a clay, colored yellow by a deposit of yellow ochre, and is a very pretty but weak pigment. I have seen it mixed with skim-milk and used in painting flower pots, with very good effect, and it was permanent, and had the advantage over oil paints in not injuring the plants. Any of the clayey ochres may be used in that way.

An ore which I have named *bog manganese*, is also a good paint, and affords a variety of colors from light or raw sienne, to a deep umber brown, the color varying with the accidental admixture of the apocrenate of the peroxide of iron, and hydrous black oxide of manganese. This may be varied also by roasting, but its changes are not so extensive as those of iron ochres. The manganesian umber paints are remarkable for drying rapidly, and are not liable to change, not being easily acted upon even by acids and gaseous emanations. This kind of paint is common in most of the swamps where bog iron ore is found, and very frequently occurs at the outlets of sluggish brooks, which run out from peat bogs and muck holes. Its origin has never yet been clearly demonstrated, but I have reason to believe it comes, in some way, from the action of peat on the rocks and soil containing silicates of manganese; for it often accompanies peat, and no other possible source of manganese could be discovered, than the minute quantities contained in the rocks and soils. The peat acids will take up the alkalies and calcareous and ferruginous matters from any rocks imbedded in the bog, and cause all rocks that are not purely siliceous, to decay, leaving a white siliceous skeleton of the stone. A piece of granite, or a quartz pebble, dug out of such a bog, is as white as snow, showing that the metallic oxides had been dissolved out. Now the apocrenates and crenates of the protoxides of iron and manganese, by becoming peroxidated, are rendered insoluble and are deposited. Hence, I suppose we may explain the origin of the ferruginous and manganesian deposits at the outlets of peat bogs.

Anterior to the discovery of the new acids of soils, and of their properties, it was impossible to account for the origin of bog iron ore, chemists previously supposing it to

be a carbonate of iron or an argillaceous hydrate, the deposition of which was inexplicable on any known principles. Berzelius first discovered the crenic, apocrenic and humic acids in the iron ochre of Porla spring, and sagaciously suggested that these acids would probably be found to enter into the composition of bog iron ore. This I have fully demonstrated is the fact. Having separated them from all the bog iron ores, I have analyzed and also made bog iron ore at will, by precipitating the peroxide of iron from the persulphate, by means of these acids. This subject being connected intimately with agriculture, I shall revert to it again hereafter.

A few other native minerals may also be regarded as paints, among which molybdena ochre may be used for a delicate yellow, and the pulverized yellow blende of Eaton will make a permanent yellowish white color, which, as I have been informed, dries well and is perfectly permanent. Neither of these substances have yet been used for this purpose in New Hampshire.

Many other substances, by chemical operations, may be converted into paints; but such materials cannot be regarded in the light of natural or mineral paints, of which alone we are treating in this section.

Black lead, or graphite, is also a mineral of considerable value to the people of the State, and its sale brings in a constant, though not very great revenue, to those who are engaged in the business. The beds of plumbago are never large, and only employ the farmers during those intervals in agricultural labor, when hands can be spared from other work. The most extensive and profitable plumbago mine is wrought in Goshen, by Mr. Henry D. Pierce of Hillsborough, who operates in the way above alluded to, and finds the business profitable. He sells about 20 tons of the ground mineral per annum, at prices varying from 3 to 5 cents per pound. It is used for the manufacture of melting pots, employed by copper founders.

The Goshen mines are situated on the side of Sunapee mountain, 1 1-2 mile S. E. from Mr. Trow's house. The bed is included in mica slate, and is accompanied by radiated black tourmaline. Its course is N. E. and S. W., and it dips to the S. E. 74°. It is also accompanied by cross veins of a very fine and pure foliated plumbago, suitable for pencils.

In Antrim, near Hillsborough, there is also a bed of very pure plumbago, situated on Campbell's mountain. The bed is irregular, varying from a few inches to 2 feet, and runs N. 10° E., S. 10° W. This locality has not yet been wrought to any extent, but the plumbago is very soft and pure.

Iron pyrites, or bisulphuret of iron, occurs in almost every town in the State, and there are some veins of sufficient magnitude to work for copperas or sulphate of iron, and they would be wrought, if the works at Strafford, Vermont, did not supply the market at a very moderate price.

In Unity, on the estate of the late Mr. James Neal, there is a very large vein of excellent iron and copper pyrites, like that of Strafford. The vein is on an average about three feet wide, and of great length. (See description in first annual report.) This locality will, in case of need, furnish copperas, sulphur, copper, and Venetian red.

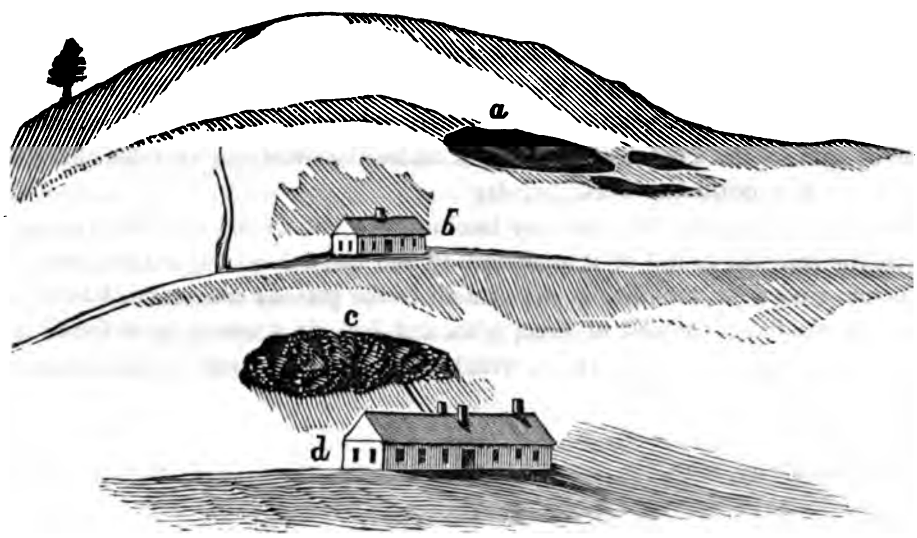
The method of managing the mineral for sulphate of iron, will be best learned by examining the copperas works of Vermont, where, by experience of years, the company has

learned the most economical processes, and now supplies nearly all the great manufacturing establishments with this valuable salt.

On visiting these works, I was permitted to make any examinations I desired, and through the politeness of the superintendent, obtained the following statistical information.

An extensive bed of iron and copper pyrites occurs at this place, and is four rods wide! The mineral is contained between the strata of mica slate rocks, and runs nearly north and south, dipping to the eastward. It is wrought in the open air, by blasting with gun powder, and although the works have been in operation for at least half a century, there seems to have been but little ore removed, the bed being so extensive that the quantity taken is small, compared with the inexhaustible supply. The ore is broken up and heaped in an immense pile, which, at the commencement of operations, is set fire to by wood fuel, but in all subsequent operations, the heat of the old heap, with the addition of water, is sufficient to cause combustion. While this combustion is going on, fresh supplies of water are required, and the liquor is returned upon the heap, until it is nearly saturated with the sulphate of iron.

The following sketch will explain the situation of the works, and exhibit the advantages of the location.



Plan of the Copperas Works, Strafford, Vt.

In 1841, these works, as was then estimated, would produce 1000 tons of crystalized copperas, which, at two cents per pound, would be worth $40,000.

The average product of late years, has been about $30,000 worth per annum. Ten men are employed at the works. Wood fuel costs $1,25 per cord. Transportation of the copperas to Boston, $10 per ton, and about the same to New York. From 1000 to 1500 cords of wood are consumed per annum. The liquor is evaporated about one half, in order to crystalize the copperas, and is then run off into the vats, where it is crystalized. It is then drained, and packed up in hogsheads and sent to market.

When these works first went into operation, the business was not properly understood, and although copperas bore a very high price, were not very profitable. They now have, by their supply, reduced the price so low as to confer a real benefit on all the factories, that depend upon them for a supply, and have thus completely prohibited the use of a foreign product, since they sell at a price about equal to the duty on foreign copperas. Nearly every New England man, who wears a black hat or black cloth of American manufacture, is a patron of these works.

A few years ago, an attempt was made to manufacture copper from the copper pyrites that occurs at this mine, but the ore was so poor, (about 7 per cent.,) that the copper cost as much as it was worth in the market, and the furnace was soon abandoned.

In case of war this mine would prove of great value to the country, for when it is required, any desired quantity of sulphur may be obtained, by distilling the iron pyrites. At the present price of sulphur, it is not worth the expense of its separation, and is much better employed in forming copperas.

It will be seen that if any of the New Hampshire pyrites mines are wrought for copperas, and enter into competition with these important works, they would probably fail in their efforts, for it would be easy to put the article at a price so low as to stop all competition, if interest should require such a proceeding. I have, therefore, discouraged the attempt.

Many localities produce, spontaneously, a small quantity of sulphate of iron, and people are too apt to attach importance to such localities. I have been called to see hundreds of them, while on the survey. They are all utterly worthless, for the small effervescence of sulphate of iron on the surface of a ledge, or under the overhanging sides of a cliff, would never amount to a farthing's worth per day.

I was told that copperas was made by leeching the soil around a mineral spring in Unity, where the soil was so full of it as to destroy and blacken all vegetation; and although it might have been an interesting experiment to the persons concerned, I have no doubt that if they calculated the cost of time, labor and fuel, they would have found it a rather expensive way of obtaining an article, which they can buy at two or three cents a pound.

METALLURGY.

Metallurgy, or the art of reducing metals from their ores and working them into different forms, is, in part, an ancient art, while the management of the more refractory metals, and many improvements in the processes generally, belong to the moderns.

The fusion and hammering of native metals constituted the earliest operations of the art, and it was not until civilization had made considerable progress, and men had permanent abodes and dwelt in villages, that the less easily reducible ores were subdued. Gold, silver, copper and lead were wrought in the most ancient times; the three first occurring frequently in their metallic state, and requiring only to be hammered into the forms desired, or, if in small pieces, to be melted together by fire. Lead is easily reduced

from its ores by the action of fire, and was probably one of the first metals, which underwent the operation of casting into definite forms; and this would have naturally led to the management of the first mentioned metals in a similar way. Tin is more difficult to reduce from its oxide, and probably was wrought at a subsequent period. It was known to the ancient Egyptians at least 3000 years ago, for among the relics found in their catacombs, are tools of bronze, consisting of an alloy of copper and tin. The ancient Phenicians procured tin from the ancient Britons, who had learned the art of extracting it from the stream tin ore, or pebbles of oxide of tin. These metals were also known to the ancient Jews, Greeks and Romans, who wrought them with some degree of skill.

Iron, in its native or metallic state, is occasionally found in meteoric stones, or masses, which fall upon the globe from the interplanetary spaces, and are supposed to originate either from volcanoes of the moon or from portions of matter wandering in space, and occasionally intercepted in their course by the earth in its orbitary rotation. Masses of meteoric iron would be easily wrought into certain forms, by the rudest barbarians, and from them the first iron weapons were probably formed. It was reserved for a more modern epoch, to reduce iron from its ores, and to cast the molten metal into useful articles. The precise time, when iron ores were first smelted, is unknown; but from the relics found amid the ruins of Pompeii, it appears that iron was known and used there, as long ago as A. D. 79.* Few iron implements would be procured amid the ruins of buried cities, on account of its ready oxidation; but masses of iron rust would indicate where the metal had lain. From the researches which have been made, it appears that iron was considered a rare and very valuable metal, which was used very sparingly by the ancients, a thin edge of it being occasionally fixed to weapons of bronze. With the improvements in the mechanical arts, the reduction of iron in forges took its rise, and for ages only forged iron was known. A blast furnace for smelting iron, with all its costly machinery, is a modern invention, and to it we owe the abundance and cheapness of that invaluable metal. Steel is a still more modern modification of iron, and consists of a fine grained carburet of the metal, generally containing small portions of manganese, or phosphorus, and in the woots, or Indian steel, a little of the metallic base of alumina, which is derived from clay. Cast steel is of still more recent origin, and possesses the greatest degree of uniformity in texture.

Zinc was unknown to the ancient metallurgists, and is obtained by distillation during the process of reduction. Its combination with copper in the alloy, known under the name of brass, was probably known long before the zinc had been seen in its metallic state, for it might have been formed by accidental admixture of the white earthy carbonate of zinc, or calamine, which may have been empyrically used as a flux for copper ore. The word brass, used so frequently in the Bible, should be rendered copper, for there is no reason to believe that the ancient Jews ever knew how to make brass. They probably understood how to manufacture the alloy of copper and tin, called bronze, which was a well known substance among the ancient Egyptians, as before observed. Some of the Egyptian chisels, which were shown me by Mr. Catherwood, are composed of bronze, and

*Tubal Cain is represented in the English translation of the Bible as a teacher of artificers in brass and iron; but this is evidently a mistranslation, for there is no reason to believe that either iron or brass were known in those early times. Copper and bronze may have been meant.

are quite hard and sharp at their edges, while they are battered and cracked at the opposite ends, on which the blows had been struck, in sculpturing hieroglyphics or ornamental work on hard stones.

For a history of the metals, see a popular work entitled, "A treatise on the progressive improvement and present state of the manufactures in metal, 3 vols., 12 mo., London, 1831;" and for an account of English furnaces and mines, see "*Voyage metallurgique en Angleterre par M M. Dufrenoy, Elie de Beaumont, Coste et Perdonnet, ingenieurs des Mines en 2 volumes, 8vo., Paris*, 1837;" also a compilation or "Dictionary of Arts, Manufactures and Mines, by Dr. Ure," London; and a "Report to the Secretary of War, relative to the working of copper ore, by Capt. G. W. Hughes of the Topographical Engineers, printed by order of the Senate of the U. States, April 10, 1844, 28th Congress, 1st Session, Doc. 291," a pamphlet containing much useful statistical information concerning English metallurgy.

In reducing metals from their ores, the operations vary according to the nature of the metals and ores, some requiring much preparation, while others are directly reduced to their metallic state by simple operations.

Supposing the ore to be an oxide of the metal, and the metal itself not volatile by the heat required to reduce it, then we have only to act upon it by carbon, at a temperature sufficient for its reduction. If the metal when reduced, is volatile, like arsenic, mercury or zinc, it is to be sublimed or distilled, carbon being used for the reduction of the oxides of arsenic or zinc, and iron is used to remove the sulphur from sulphuret of mercury. The last mentioned metal has not been found in the United States. If the metal is readily oxidated by air at a high temperature, then it becomes necessary to add a substance which, by its fusion, will form a liquid envelope or flux, which is also used for the purpose of separating the foreign matters, that are generally mixed with metalliferous ores, and its nature must be determined by that of the substances in the ore.

Thus, lime or limestone is used as a flux for all varieties of iron ore, because they generally contain a considerable proportion of silex and alumina, and those ingredients, with lime, melt readily in combination with a small proportion of the oxide of iron, and form a fusible slag, which floats above the melted iron. If the ore contains no alumina, it is advantageous to put in a certain proportion of clay with the limestone, and if it contains too much of it, a proper proportion of siliceous sand is thrown in, to form a more fusible slag.

The skillful master of a furnace endeavors to produce a favorable result, by an admixture of different kinds of iron ore, when he can obtain such as will answer his purpose, but there are very few who understand the principles of the art; and hence there are many furnaces sadly mismanaged, and a vast quantity of iron is often lost in the slag. Were the workmen generally acquainted with the principles of chemistry, this difficulty would be readily overcome. The regulation of the blast is also an important matter in the management of a smelting furnace. If too large a volume of air is thrown in, the charge is heated far up in the furnace, and an unnecessary quantity of coal is consumed, while a large portion of the iron is burnt, or again converted into an oxide. This trouble is also produced by the want of a proper direction in the blast pipes, and tuyeres. The volume of

air should be small as is consistent with the requisite heat, and the iron should not be melted until it is nearly opposite the tuyeres. A good furnace master watches this part of the work with the utmost attention, and can distinguish in a few moments if all is going on right. He perceives, when the reduction is going on favorably, a rapid rotary motion of globules of the iron, and drops of the metal are seen sinking rapidly below the tuyeres into the crucible of the furnace. If there is a rapid scintillation, he knows that he is burning the iron, and diminishes the blast or adds more coal. If he sees that the iron does not drop freely, he adds more flux or alters its nature, according to his judgment and experience. The condition of the slag is also an indication of the working of the furnace, which he is very attentive in examining. When the operation has been well performed, the slag is a dark green or blue glass, free from any globules of iron or of unreduced ore. If it is a rough porous black slag, filled with large globules of iron, or with pieces of the ore, he knows that the work has not been properly done, and if he has the means, endeavors to remedy the difficulty in his future operations. There are very few metallurgic processes that require a more thorough knowledge of chemistry than the manufacture of iron, and it is a matter of surprise that by mere empyricism, iron smelters have been able to effect their operations so well as they have done, while at the same time, they will generally acknowledge that they would have been able to have done much better, if they had understood the chemical principles of the art.

Cast iron is made by the reduction of the oxide to its metallic state, by the action of carbon or coal, at a high temperature, and by the union of a portion of the carbon with the metallic iron, forming a coarse carburet. A small quantity of the metalloid base of silex or silicium, is also frequently contained in cast iron, and it is not uncommon to find small proportions of other metals united with it.

The kind of furnace used for smelting iron ores, by means of charcoal, is represented in the woodcut on page 199, and is called a blast furnace. It is constructed of stone, is lined with firebrick, and has a hearth of talcose granular quartz, or of sandstone, or some other refractory material. Between the inner lining and the stone work of the stack, there is a layer of sand, which acts as an imperfect conductor of heat, and prevents the expansion and contraction of the lining from heaving open the walls of the furnace. The whole stack is thoroughly braced and girded by numerous iron bands and bars, to keep it firmly supported.

There is an expansion near the base of the furnace, called the boshes, and the top is called the tunnel head. At the bottom is the crucible hearth. In the sides of the crucible the tuyeres or blast holes are made, and either one or two are used, according to the nature of the furnace. The arches, when they are placed, are called the blast arches. The blast is generally made by means of large tub bellows or iron cylinders, placed in a separate building, and worked by water or steam power, a large air reservoir being provided for giving steadiness to the blast, by the compression of air into it, on its way to the blast pipes; or sometimes there is a third tub, loaded, on its movable top, with heavy weights, which serves as a reservoir for the air, from whence it is taken by iron pipes to the furnace.

The above description applies to the cold blast; but when heated air is used, it is conducted directly from the reservoir to the series of tubes destined to heat it, which are placed

either in a separate furnace or above the tunnel head, in a large box or space constructed of bricks, where the iron tubes are heated to the temperature of melted lead. Then the air passing through them, becomes heated, and is conveyed to the blast arches, by perpendicular tubes, down the sides of the furnace, and is driven in by close tuyeres, kept cool by a current of water around them, near their terminations, where they would otherwise become too hot and burn. Whenever close tuyères are used, this is indispensable; and since the air quickly passes by, it is but little cooled in its transit through so small a space.

Hot blast iron, made with coke or coal, is liable to be short or brittle, and is in very low repute, and much cheaper than that made by cold blast; but this difficulty does not attach itself to the manufacture of iron by charcoal, and iron ores free from sulphur; and since a much larger daily product of iron is obtained by less consumption of fuel, the hot blast is applicable to many of our New England furnaces. I understand that the hot blast has recently been introduced, at my suggestion, in the Franconia iron furnace, but I have not yet witnessed the result, the change having recently been made. It is used in some of the blast furnaces in Vermont, with great economy.

Good cast iron, suitable for re-melting, should be of a very large grain, or coarsely crystalized, with plates of carburet of iron intimately mingled with it. Its color should be grey, and it should be soft under the file or chisel. This kind of iron will always bring the highest price, and is valued just in proportion as it resembles the Scoth grey pig iron, so much used by our iron founders for re-melting. It is made by carefully adjusting the blast so as not to burn out the carbon.

I have had occasion to visit many iron furnaces and founderies, and often have been able to direct the workmen so as to make a very good soft grey iron, where they previously made only a very hard and white metal. In re-melting, anthracite is the most compact fuel, and is preferred to all others, on account of the intense heat it produces; so that very sharp castings may be made with the liquid iron.

The close tuyere is the best in re-melting furnaces for castings, and the volume of the blast should be as small as will answer to produce the required heat. If any more air is thrown in than is required for the combustion of the coal, the carbon is burnt out of the iron, and a hard white metal results, which is not prized by machinists, since it is brittle, and does not turn and plane easily. In a small re-melting furnace in Haverhill, I was informed that they could not use any other than Scotch grey pig iron, and that they had to pay $20 per ton for its transportation from the sea board; and on suggesting to the proprietor that he might make equally good iron from that of Franconia, by altering the tuyeres of his furnace as above mentioned, he followed this advice, and obtained the most satisfactory results, saving thereby the transportation of iron from Boston, and obtaining it from the Franconia works. At this little foundery in Haverhill, Lehigh anthracite is used with economy, although it costs, in addition to its price on the sea board, $20 per ton for transportation. Anthracite is also used in the re-melting furnace at St. Johnsbury, Vt., at a cost of $50 per ton for transportation. This fact will show one item of importance in the advantages to be derived from railroads, by which the cost of transportation will be diminished.

Charcoal makes the best foundery iron, but it does not answer so well for re-melting the

pigs for castings, since it is not sufficiently dense to give an intense heat in a small space. The castings made with anthracite fuel, can be made much thinner and sharper in their impression than iron re-melted by charcoal.

Forges.

Bar iron. Iron may be reduced from its ores in the Catalin forge, charcoal being used for fuel, and lime and clay for a flux. The metal sinks into a bed calculated to receive it, and when a sufficient mass, cake or lump of it is obtained, it is thrown out by means of bars of iron, and taken on a crane to the forge, or trip hammer, where it is worked over, and the slag driven out, and the particles of iron brought into close contact. It is then heated again, and the operation renewed, until a large and massive bar of wrought iron is obtained.

Pig iron is treated in a similar way, and is thus converted into bar iron. While in the forge, it is worked over very freely, with a heavy iron bar, and turned in all directions to the blast, and occasionally masses of clay are thrown in and worked over with the iron, to separate the impurities in the state of a slag. This process is very laborious, and in large works is superseded by extensive puddling furnaces, where the iron, as the carbon is burned out, becomes less and less fusible, and is finally balled up by means of iron bars, and withdrawn and hammered by powerful machinery. Bar iron is also made by the direct reduction of magnetic iron ore, by means of charcoal, the finely pounded ore and coal being made into balls, and heated to whiteness in large fireclay tubes, retorts, or muffles, in a reverberating furnace, and then hammering the metallic iron together by means of a piston, fitted into an iron cylinder, and driven down with great force by machinery.

Most of the rich magnetic iron ores of New Hampshire may be readily converted into bar iron by this direct process, which is, as yet, but little known in this country.

Steel is a combination of carbon and iron, and differs from cast iron only in its greater purity and fineness of grain. It is made by submitting iron bars to the action of fine carbon, in close muffles, the iron being penetrated by the carbon, which combines with the iron. In this state, it is blistered steel, and when re-melted in crucibles, is cast steel. Case hardened steel is made by heating plate steel to dull redness, in a close vessel, with animal carbon, made of pieces of old leather, horns, hoofs, &c. The surface of the plate is fully carbonized, and when withdrawn, and plunged into water, is hardened, and the temper is drawn by taking it out instantly, and after allowing it to cool to the proper point, re-plunging it in water. More refined methods are practised by workmen in manufacturing cutlery, &c.; baths of lead, oil, &c., being used according to the temper desired. An iron ore, to make the best kinds of steel, should contain a minute proportion of manganese, which renders iron ores containing it, convertible directly into steel, without going through the tedious process of conversion into bar iron, &c.

The iron ore of Bartlett, N. H., is of this kind, and may be made into steel directly, if well managed; for the oxide of manganese, it contains, will furnish oxygen in adequate quantities to burn out the excess of carbon, and convert the metal into steel. This was

proved by actual trial in a forge, the metal obtained, much to the surprise of the persons interested, being a coarse kind of steel.

Roasting of iron ores.

When iron ores contain sulphur, it is very difficult to remove it entirely; but the quality of the ore is very much improved by roasting it at a low temperature, by means of wood fuel. The process is commonly carried on very rudely, the ore being piled on a heap of wood, which is then set on fire and allowed to burn away slowly. When greater nicety is required, kilns are constructed for the purpose, and are shaped very much like common lime kilns, being, however, generally contracted at the bottom, so as to support the charge of ore above the fire arch. The smell of sulphurous acid is perceived, when the ore contains sulphur, and when it ceases to be sensible to the smell, the ore is sufficiently roasted. It now breaks up under the hammer more readily, and much labor is saved, insomuch that it is economical to roast all iron ores, previous to breaking them for the furnace. Iron ore that is heavy, should be broken small, and the pieces are not to be larger than walnuts, if possible, but more frequently it is thrown in of the size of eggs. Poorer or lighter ores, like bog iron, may be broken as large as the fist; but it is better to have a mixture of two kinds of ore, of different sizes and qualities. The flux is also to be broken into small pieces, before it is thrown into the furnace. The ore and flux are measured by boxes, containing a certain convenient measure. Charcoal is measured in by baskets, generally holding two bushels each. The proportions of iron ore, flux and coal vary with the kinds of ore wrought, and the state of the furnace.

When once in operation, a furnace keeps in blast, steadily, until the hearth stone gives way, or the supply of ore and coal are exhausted, or the market is supplied.

Generally, the autumnal and winter months are chosen to put the furnace in blast, the workmen then being obtained at lower wages, and the outdoor workmen being called in.

"It has been ascertained, also, that a larger quantity of iron is reduced, in a given time, in the winter months," which is supposed to be dependent on the more condensed and drier state of the atmosphere, by which the nature of the blast is modified; while the draught of the furnace is also affected by the greater difference of temperature between its heated gases and the surrounding air. This seems to be a sufficient explanation of a fact which has puzzled the workmen and some writers on the subject.

Preparation and charge for an Iron Furnace.

The iron ores being properly roasted and broken, and the limestone used for flux being also broken into small pieces, the furnace, about to be put in blast, is gradually heated, some ignited coals being thrown in, and charcoal added by degrees, until the furnace is filled; while but little air is admitted to the fuel, which gradually becomes ignited throughout the furnace. During this process, a large quantity of moisture is seen to arise from the sides of the stack, vapor pouring out from all the vent holes, made for the purpose, and the furnace becomes tempered, so that it is less liable to crack and heave in the subsequent operations.

When the furnace has become properly heated, and the fire has reached the top of the coals, then the charge is added little by little, and the blast pipes are placed in the tuyeres, and the blowing engine put in operation. By the time the fuel, below the ore first thrown in, is consumed, liquid iron begins to appear in the crucible, and the furnace is then fairly in blast, and may continue for months steadily in operation, no cessation being admissible after the work has begun, until the term of the blast expires, or the hearth gives way. The iron, by its superior specific gravity, settles through the liquid slag into the bottom of the crucible, and the slag is drawn off from its surface by the fireman; and when the crucible is full, the casting is effected, an opening being made at the hearth, when the metal flows into the sand mould, prepared for it, the central and larger mass being called by the workmen the sow, while the smaller ones, on each side, are called the pigs. When castings of smaller size, and of determinate forms are required, the metal is first drawn into a dam, close to the crucible, from which the melted metal is dipped by means of iron ladles, lined with refractory clay, and the melted metal is then poured into moulds, prepared for the casting, the surface of the iron being skimmed while it is poured by the workmen.

The following are the proportions used in charging the blast furnace of Franconia, cold blast being used at the time:

15 bushels of charcoal;

5 boxes, containing 56 lbs. each, of magnetic iron ore;

1 box of limestone, for flux.

The average daily product of this furnace, while in blast, is two and a half tons of pig iron and castings per day; but on commencement of the blast the product is one and a half tons per day.

This furnace was erected in 1811, and has been in operation since that time, and produces from 250 to 500 tons of excellent cast iron per annum. Part of it is reduced to wrought iron in the forge, where from 100 to 140 tons of the best kind of bar iron are made. The furnace is kept in blast from 16 to 26 weeks during the autumn and winter.

From two to three hundred thousand bushels of charcoal are consumed, per annum, at this furnace. Hard wood charcoal costs $4 per 100 bushels; spruce, or soft wood charcoal, $2.50 per 100 bushels.

Limestone, used for flux, costs $1 per ton.

The ore costs $6 per ton at the furnace, the expense of obtaining it being made up of the following items:

Mining, - - - - -	$5.00
Hauling to furnace, - - -	50
Breaking, - - - - -	50
	$6.00

The average product of cast iron is 60 per cent. on the ore smelted, but the pure ore contains 69.04 per cent. of iron, as will be seen by the following analysis—

100 grains of the granular magnetic iron ore of Lisbon iron mine, contain—

Prot and peroxide of iron, - -	96.20

Silica, - - - - -	2.30
Titanic acid, - - - - -	1.50
	100.00

96.20 per cent. of the above oxides contain 69.04 per cent. of metallic iron.

Ten miners are employed, at the rate of $15 per month, by the contractor.

Pig iron sold at the furnace in 1840 for 2 cts. per lb.; castings at 5 cts. per lb.; and bar iron at 5 1-2 cts. per lb.

One hundred workmen are employed by the Franconia furnace for half the year, and about half that number for the entire year. Thirty men are entirely supported by their labor at the furnace, and one half of that number have families.

Since the establishment of these works, Franconia has risen from the state of a perfect wilderness to its present condition, having now a population of 550 souls. Every proper inducement should be offered to forward the active enterprise of this corporation, since their operations are of great value to the citizens of the State, an abundant supply of the best kind of iron being made from materials, which, in their native state, were worthless, and an active and hardy industry being encouraged and supported, while a market is furnished for the produce of the soil in the vicinity. These works also serve as a good school for the instruction of practical iron smelters, founders and bloomers, and thus numerous workmen become prepared to engage in operations at any other works that may be erected.

It should be remembered that in the early stages of this enterprise, the Franconia iron company expended vast sums of money in learning the business, and in researches for iron ores; and if they have since made their works profitable, it has been by their own enterprise, industry and acquired skill. They have much to struggle with now, owing to the low price of foreign iron and to the scarcity of money among their home consumers.

The following is an account of the condition of the works in 1838, a year in which the business was profitable. It was kindly furnished, at my request, by Captain Putnam, the skillful superintendent of the furnace:

DR. BLAST FURNACE, WINTER, SPRING AND SUMMER OF 1838. CR.

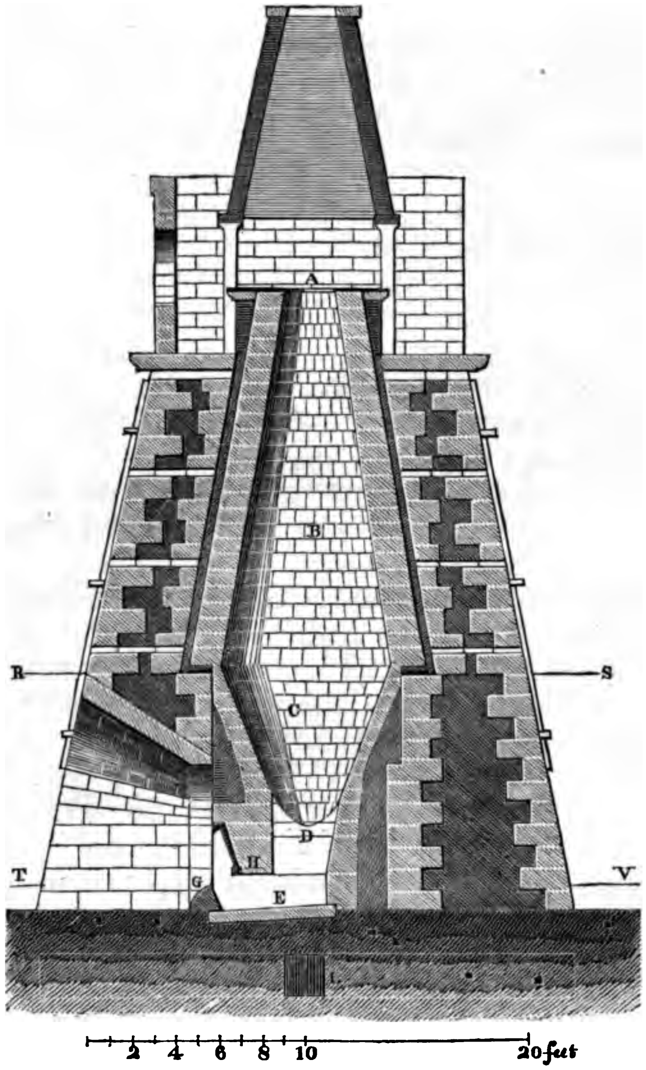
1838.	To	109,709 bushels coal,			1838.	By	729,749 lbs. Pig and Scrap, at 2c.,	14,594	98
July 1.	"	21,940 added for wasted and dirt,			July 6.	"	182,728 lbs. Castings, at 4c.,	7,309	12
		131,649 bushels coal, at 4 1-2c.,	5,924	20					
	"	690··17··1··21 lbs. ore, at $6 50,	4,490	67					
	"	77··17··0·· 0 lbs. limestone, at $1.25,	97	31					
	"	8 loads clay, at $1.00,	8	00					
	"	Labor and board of hands,	2,297	97					
	"	Blacksmith's bill,	85	48					
	"	Moulding sand for blast,	40	00					
	"	Use of flasks and patterns,	25	00					
	"	Repairing flasks and patterns,	30	00					
	"	Hearth drawing and laying same,	100	00					
	"	Agency and clerks,	500	00					
	"	26··10··0··0 lbs shot iron, at $20,	530	00					
		Net,	7,775	47					
			$21,904	10				$21,904	10

The ore yields 55.12 per cent. of iron.

About 160 bushels of coal are required to smelt a ton of the ore.

The blast continued 24 weeks.

The following figure represents a vertical section of a blast furnace for smelting iron ores, in which charcoal is used for fuel.



Blast Furnace.

A, throat or tunnel head, into which the fuel, ore and limestone are thrown, in charging the furnace; B, conical body of the furnace; C, inverted conical part of the furnace, or the boshes; E, crucible of the furnace; F, hearth or bottom of the crucible; G, dam; H, tymp. The tuyeres are not seen in this section. They come in on the line, T, V, and are represented in a transverse section, in M. Dumas' plates.

The space between the walls of the furnace is filled with sand or scoria, which allows the inner part or lining to expand and contract without heaving the walls open. The work

is strongly bound together by iron clamps. Under the hearth is a drain to take off the water which might collect in the soil.

This is the most usual form of the blast furnaces used in New England, and the hot blast is easily added, by fixing pipes in a box above the tunnel head, and driving the blast through them.

This drawing is copied from a plan published in the work of M. Dumas, "*Chimie applique aux Arts*," and represents so nearly the structure and proportions of the Franconia furnace, that I have not thought it necessary to print my sketch, which was made from measurements taken when cold blast was used at that furnace.

The stack of Franconia furnace, by my measurements, is 34 feet high, 8 feet 3 inches in diameter at the boshes, or 12 feet before the lining was put in.

The boshes are 6 feet above the hearth.

The blast arch is 8 feet 8 inches wide.

The casting arch is 11 feet wide.

I have not had an opportunity of examining it since the alterations have been made, but suppose that the form of the furnace cannot be materially changed.

Iron ores are abundantly scattered in the rocks and soils of New Hampshire, and some of the localities will furnish a supply for a blast furnace for ages, while others are limited deposits, which may be wrought when they are so situated that the ore can be cheaply transported to a furnace which may receive its supply from several localities in its neighborhood. This is the only method of working the thousands of small deposits of bog iron ore, which are scattered over the State in such profusion, but rarely contain an adequate supply for a furnace requiring four or five tons of the ore per day, for six months in the year. When the price of iron is sufficiently high, these small deposits may be wrought for bar iron in the Catalin forge; but that method of working cannot be put in competition with the blast furnaces at present in operation, nor can the forge make iron from bog ore at a sufficiently low price, to render the work profitable at the present prices.

We should therefore confine the attention of those who may contemplate the erection of iron works, to a few localities, where there is decidedly an ample supply of good iron ore, and charcoal fuel may be obtained in any desired quantity, at a moderate cost.

There are two places in New Hampshire, where I have no doubt iron may be made, of good quality, as cheap as it can be made with charcoal, and of as good quality as the best foreign iron made with similar materials.

Those localities are Cross' hill in Piermont, and Bald face mountain in Bartlett.

The Piermont ore is the compact, specular and micaceous iron ore, and is occasionally mixed with small veins of magnetic iron ore. Its locality has been fully described in the topographical part of this report, and all that is required in this section is an acconnt of its chemical composition.

A solid and nearly pure piece of the ore yielded by chemical analysis—

Peroxide of iron,	93.5
Titanic acid,	3.8
Silica, (quartz,)	2.7
	100.0

It contains, then, 64.8 per cent. of pure iron.

An average specimen yielded—

Peroxide of iron, - - -	75.0=Iron, 54.07
Titanic acid, - - - -	3.8
Quartz, (from the gangue,) - -	18.2
	100.0

The average yield of the ore in a blast furnace will be about 50 per cent. of iron.

The Piermont iron mine is favorably situated for advantageous operations in the manufacture of iron. The ore is abundant and the mines will need no artificial drainage. Water power is close at hand, and is unoccupied at present. Charcoal may be had, in any desired quantity, for three or four dollars per 100 bushels. Limestone occurs in abundance near by, in Haverhill. Stone, proper for the construction of a blast furnace, is found in the immediate vicinity. The roads are good, and provisions are as cheap as in any other part of the State.

It is to be hoped that some enterprizing and skillful persons will undertake the working of this mine, and that it may not be made to subserve the schemes of any ignorant speculators.

The iron ore on Baldface mountain in Bartlett, is also very rich and valuable. Its extent has been stated in a preceding section of this report, page 79.

The ore consists of a mixture of the peroxide and the protoxide of iron, the former largely predominating, so as to give to the pulverized ore a deep red color. It is but slightly magnetic, owing to the larger proportion of the peroxide.

It is also mixed with a minute proportion of oxide of manganese, which will have a favorable influence in the conversion of the iron into steel; for the oxide of manganese, giving out a portion of its oxygen, tends to reduce the proportion of carbon which enters into the composition of cast iron, so as to bring the iron into the condition of steel. The celebrated Swedish chemist, Berzelius, is of opinion that manganese exerts a very favorable influence in this manner, and from observation, it is well known that such is the result.

The Bartlett iron ore was analyzed by me seven years ago, and it was proposed then to erect a blast furnace for the manufacture of iron; but embarrassments in the commerce of the country prevented any investment of capital in the business at that time. I would again call public attention to the immense veins of iron ore which exist in that town, for I am satisfied that few localities in New England can compete with that locality, in the abundance of the ore and cheapness of fuel.

It contains from 48 to 50 per cent. of pure iron, on the average, as ascertained by several analyses, and from 1 to 5 per cent. of manganese.

100 grains of the ore was analyzed in my laboratory, by Mr. Williams, who obtained—

Peroxide of iron, - - -	69.4
Quartz and felspar, - - -	25.2
Oxide of manganese, - - -	2.7

69.4 of peroxide contains 48.117 per cent. of metallic iron.

Another specimen yielded—

Felspar and quartz, - - -	21.40
Alumina, - - - - -	.15
Manganese, - - - - -	1.20
Peroxide and protoxide of iron, by difference,	77.25
	100.00

or 53 per cent. of metallic iron.

We may therefore calculate upon at least 48 per cent. of cast iron, as the result of the smelting operations of a blast furnace.

The following analyses exhibit the composition of a number of other iron ores found in New Hampshire, the localities of which are fully described in the preceding report of the survey, many of them being of considerable importance.

100 grains iron ore from Thorn mountain, Jackson, E. and W. vein, yielded—

Silica, - - - - -	43.6	
Peroxide of iron, - - -	54.8	
Loss, - - - - - -	1.6	grains.
	100.0	

It contains 37.99 per cent. of iron.

100 grains magnetic iron ore from Unity, yielded—

Siliceous matter, - - -	4.
Peroxide of iron, - - -	90.4
Titanic acid, - - - -	6.8
	101.2

It contains 62.6 per cent. of iron.

Magnetic iron ore, Winchester, 100 grains yielded—

Silica, - - - - -	66.6	
Peroxide of iron, - - -	34.	
	100.6	
Gain, - - - - - -	6	oxygen absorbed.
	100.0	

It contains 24.26 per cent. of iron.

100 grains hæmatite iron ore, Lebanon, yielded—

Silica, - - - - -	6.
Peroxide of iron, - - -	94.
	100.

It contains 65.178 per cent. of iron.

100 grains hæmatite iron ore, Black hill, Benton, yielded—

Silica - - - - -	8.0	
Peroxide of iron, - - -	90.0	
Loss, - - - - - -	2.	grains.
	100.0	

It contains 62.40 per cent. of iron.

Bog iron from Six Mile pond, Eaton—100 grains yielded—

Water,	4.
Vegetable matter,	12.
Silica,	12.
Peroxide of iron,	72.
	100.

It contains 49.92 per cent. of iron.

100 grains bog iron from Col. Tuttle's, Barnstead, yielded—

Water,	8.4
Vegetable matter,	9.8
Silica,	9.4
Peroxide of iron,	71.6
Loss,	0.8
	100.0

It contains 49.71 per cent. of iron.

100 grains nodular bog iron from Barnstead, yielded—

Water,	30.
Vegetable matter,	10.8
Silica,	2.8
Peroxide of iron,	52.8
Manganese,	2.4
	98.8

It contains 36.5 per cent. of iron.

100 grains bog iron ore from Charlestown, yielded—

Water,	6.6
Vegetable matter,	18.6
Silica,	4.6
Peroxide of iron and traces of manganese,	69.4
Sulphuric acid,	.48
Loss,	.32
	100.00

It contains 48.12 per cent. of iron.

100 grains bog iron ore, Haverhill, yielded—

Water,	9.
Vegetable matter,	12.8
Siliceous matter,	4.6
Peroxide of iron,	72.6
	99.0

It contains 50.31 per cent. of iron.

100 grains bog iron ore from Lebanon, brownish yellow, yielded—

Water, - - - -	5.8
Siliceous matter, - - -	7.6
Vegetable matter, - - -	15.0
Peroxide of iron, - - -	70.6
	99.0

It contains 48.95 per cent. of iron.

100 grains bog iron ore, Milford, yielded—

Water, - - - -	3.2
Vegetable matter, - - -	8.8
Silica, - - - - -	8.0
Peroxide of iron, - - -	80.0
	100.0

It contains 55.47 per cent. of iron.

100 grains bog iron ore from Col. White's farm, Lancaster, yielded—

Water, - - - -	13.
Vegetable matter, - - -	12.
Silica, - - - - -	2.6
Peroxide of iron, - - -	71.2
Loss, - - - - -	1.2
	100.0

It contains 49.56 per cent. of iron.

Good bog iron ore is also found in Pelham, in the north part of the town, and has been carried to Chelmsford furnace and wrought. It is found on the land of Mr. Jesse Gage, in the middle of the town, and on the estate of Mr. Andrew Tallant. These deposits are not in themselves sufficient to supply a furnace, but can furnish a contribution of some importance to the works above mentioned. The ore is dug at a season when there is but little else to be done.

Tyson's Furnace, Plymouth, Vt.

After inspecting a hot blast furnace in Plymouth, Vt., I became convinced that it would prove advantageous to introduce hot air blast into the Franconia furnace, and on suggesting this to the superintendent, he visited several hot blast furnaces in Vermont, and has since made preparations for its introduction at Franconia.

The following statistical information was obtained from Mr. A. Haven, the agent of the Tyson iron furnace, in Plymouth, Vt., where hæmatite iron ore is smelted with charcoal by hot blast:

This furnace was erected in 1837, and put in blast in the autumn of that year.

It is kept in operation three months at a time, beginning in April or May ; and there are generally three blasts per annum, continuing about nine months in the year.

From 100 to 150 men are employed in and about the works at present: 20 are employed in making charcoal, and 30 in the furnace operations, viz:

20 moulders;
2 firemen;
2 top men;
2 plate brushers;
1 founder;
1 coal man;
1 picker of the ore;
1 roaster of the ore;
—
30

From three to six smiths are also employed in various operations in the stove shop.

Ten miners are employed in extracting the ore from the earth; six teamsters; six farmers; three clerks; one agent; and one manager.

The wages of the laborers vary from $14 to $18 per month.

The foreman has a salary of $500 per annum; the first moulder $1.50 per diem. Ordinary moulders receive from $1 to $1.25 per diem.

One hundred bushels of coal, with *hot blast,* makes one ton of iron, and when *cold blast* was used, the same amount of iron required *one hundred and fifty bushels of charcoal.*

The charge for the furnace consists of 12 bushels of charcoal, from 8 to 14 boxes of iron ore, according to its quality, and 2 boxes of limestone, for flux.

From three to five tons of pig iron are produced per day.

The pig metal sells for $35 per ton. Castings sell at from 4 to 5 cents per lb.

An immense number of stoves are cast at this furnace, and are generally in good repute, but they are not so fine and smooth as when the iron is re-melted by means of anthracite. The pig iron is a good soft grey metal, suitable for founderies.

The iron ore was discovered on the hill near the furnace. It is a compact brown hæmatite, and occurs in rounded masses, or lumps, in the soil.

A shaft has been sunk to the depth of 50 feet, and a gallery, or level, has been made in a N. E. and S. W. direction, for the distance of 1400 feet, extending to the brook into which the waters of the mine are drained. This level is 4 feet wide and 6 feet high. In excavating it, a bed of good fine clay was discovered, which is highly valued, and is rumored to have already saved the works a thousand dollars; while it is also valuable, and is sold to the bloomers and founders of the neighbourhood for $2 per ton.

The bed of hæmatite iron ore is from 14 to 16 feet wide, and at least 300 feet long, but not solid; hence it cannot be calculated to last for any very great length of time.

Black oxide of manganese is found on the S. W. side of the gallery. It occurs in solid lumps, from the size of a walnut to about that of the fist.

Twenty-five tons of this ore have been raised and sold in New York for $25 or $30 per ton.

Micaceous specular iron ore occurs in the limestone of Plymouth, and is occasionally mixed with the hæmatite in the furnace. Spathose iron ore, or the crystaline carbonate,

is also found in more limited quantities. Limestone is very abundant, and may be had for the trouble of blasting it out and transporting it to the furnace.

Iron holds the first rank among the useful metals, and is essential to civilized man; for most of the arts are dependent upon it for the supply of instruments, which are absolutely necessary for their prosecution.

Civilized man alone makes use of it, and to that metal he, in a great degree, owes his superiority over the savage. Science and skill in the arts, and a fixed abode are essential to its manufacture, and, therefore, it has never been reduced from its ores by any but civilized people.

Its magnetic properties guided the skillful navigator across the ocean, and enabled European civilization to extend itself to this continent. Arms manufactured from it, enabled the first settlers to withstand the inroads of barbarians; while the more peaceful implements, the axe and the plough, constructed also of this metal, enabled the colonists to subdue the forest and to cultivate the soil.

Zinc.

This metal is daily becoming more important in the arts, and has been steadily rising in price for some years past. Although in its state of spelter, or cast zinc, it is largely crystaline and brittle, yet when heated to about 300° F., it rolls out easily into thin sheets, which are compact and comparatively tough. It is used in sheets for covering the floors and roofs of dwellings, and for lining sinks and cases of various kinds. Being devoid of magnetism, it is largely employed in lining the bread lockers of ships. On account of its lightness, comparative difficulty of corrosion and hardness, it is preferred for many uses, where sheet lead and tinned iron were formerly employed.

Zinc is also used for making various alloys with copper, among which are brass, yellow metal and pinchbeck. It has also been employed in washing the surface of iron, or galvanizing it, so as to render the iron less susceptible of oxidation.

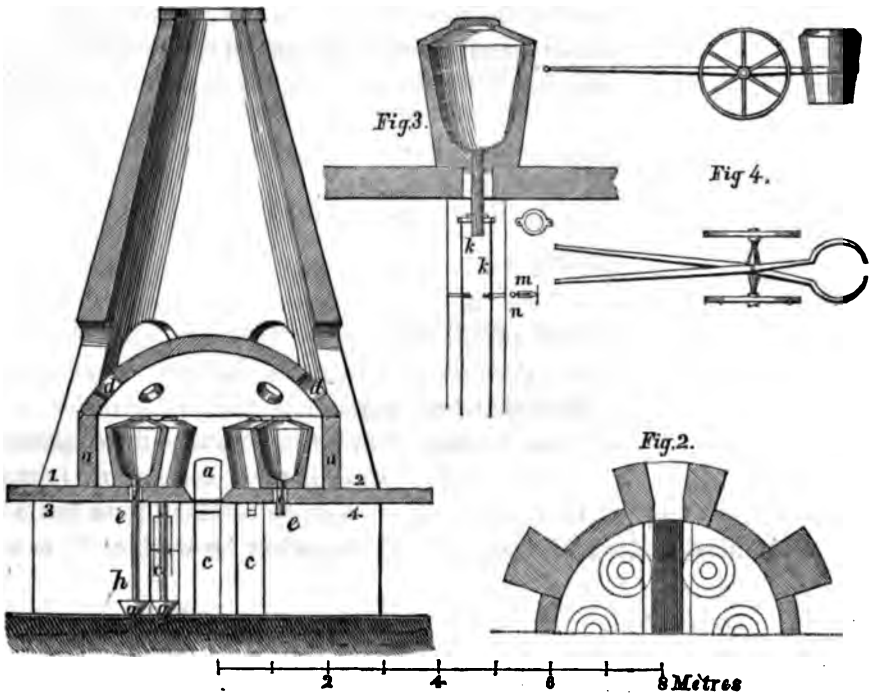
Its ores are calamine, or carbonate of the oxide of zinc, and blende, or sulphuret of zinc. Small quantities of the first mentioned ore are found in the town of Eaton, while the sulphuret is exceedingly abundant in that and other towns in the State. The purest blende is the yellow variety found in Eaton, where it forms a vein five feet in width, and is associated with calamine, purple fluor spar, carbonate of lime and argentiferous galena. The blende is the most abundant mineral in the vein, and will prove valuable to those who may, by economical methods, undertake its extraction.

By roasting the blende in a reverberatory furnace, it is readily converted into oxide of zinc, the sulphur being consumed and passing off as sulphurous acid gas, while the oxygen of the air combines with the zinc and forms oxide of zinc.

The oxide thus prepared, is then to be reduced by mixing it intimately, by grinding, with an excess of charcoal, and distilling it either in large fireclay tubes, or perforated crucibles, having tubes passing out from the bottom into pans of water; the top of the crucible being secured by a cover, luted on by fireclay. The metal, as fast as the carbon takes the oxygen from its oxide, rises in vapor and passes down the tube, condensing into liquid metal, and falling into the pan of water below, in irregular masses. On the com-

pletion of the process the zinc is removed and melted in iron vessels, and cast into large square masses, in an iron ingot mould.

The following woodcut represents an English zinc furnace, and is copied from the admirable report of Elie de Beaumont and Dufrenoy, on the English mines and furnaces. (See *Voyage Metallurgique en Angleterre par M M. de Beaumont et Dufrenoy.*)



English Zinc Furnace.

Fig. 1, vertical section of the furnace passing through its axis. This furnace is circular. It is enveloped by a cone which serves for a chimney. This chimney has doors opposite the crucibles.

a a, walls of brick movable at pleasure, to admit of placing or removing the crucibles. These bricks are perforated with a hole to admit an iron rod, so that they may be taken down while hot.

b, door of the oven closed by a brick.

c, ash pit, large enough to admit a man to clear the grate.

d d, holes in the upper part of the dome. They serve to give passage for the smoke; also to allow the crucibles to be changed. They are never all closed at a time. The workmen may thus direct the flame to any part of the furnace at pleasure.

e e e, openings in the inferior story, which correspond to the crucibles in the upper part of the furnace.

g g, receiving basins of cast iron, into which the zinc falls.

h, cylindrical tubes of cast iron, which conduct the zinc to the basins.

i, condenser; it is a tube of cast iron, slightly conical, having a little rim by which it is applied to the crucible. Some clay is put on this rim to make the joint tight, and it is firmly pressed against it. To secure it in this position, there are two iron rods, *k k*, which are fixed to the lower part of the condenser by a button, and pass into a piece of iron, *m*, fixed in the wall: a screw, *n*, presses the rods.

Fig. 3 shows the details of this apparatus, which is used to fix the condenser to the bottom of the crucible. 1, 2, level of the upper story. 3, 4, lower platform.

Fig. 2, plan at the level, 1, 2, the drawing being one half of the section.

Fig. 3, vertical section of a crucible, with the details of the apparatus used for adjusting the condenser.

Fig. 4, pincers on wheels to transport the hot crucibles.

Zinc or Blende ore of Eaton.

In the town of Eaton, near Snell's pond, occurs an important vein of zinc and lead ores. The dimensions of this vein, as before stated, are sufficiently great to warrant mining operations, since a vein of six feet wide affords ample room for the miners. Although an attempt was made about twelve years since to work this mine for lead, no attention was paid to the zinc ore, which is vastly more abundant, and affords a more reasonable hope of reward. At that time no person in this country knew how to manage the sulphuret of zinc; but now it can be done, and zinc has come into such general demand as to warrant the belief that a valuable supply of that metal will ere long be obtained from this mine.

Results of a chemical analysis of 100 grains of the yellow brown blende, or zinc ore of Eaton—

Sulphur, - - - -	33.22
Zinc, - - - - -	63.62
Iron, - - - - - -	3.10
Cadmium and loss, - - -	.06
	100.00

100 grains blende from Warren, contain—

Sulphur, - - - -	26.6
Zinc, - - - - -	62.5
Iron, - - - - - -	9.6
Cadmium, - - - - -	1.3
	100.0

100 grains blende from Shelburne, contain—

Sulphur, - - - - -	32.6
Cadmium, - - - - -	3.2
Iron, - - - - - -	10.
Zinc, - - - - -	52.
Manganese, - - - - -	1.3
	99.1

100 grains blende from Lyman, contain—

Sulphur, - - - -	33.4
Cadmium, - - - -	2.3
Iron, - - - - -	8.4
Zinc, - - - -	55.6
	99.7

These ores yield from 30 to 40 per cent. of zinc, by distillation in earthern retorts, the ore being first thoroughly roasted or oxidated, and then mixed with charcoal powder and put into the retort, which is then to be heated to a white heat, a tube being fixed to the retort neck and dipping into water, into which the distilled zinc falls in globules and irregular pieces of an oblong shape. In the commencement of the distillation, the first metal which rises contains the most cadmium, and may be separated for analysis, if that metal is wanted. It does no harm to the zinc, when mixed with it, since it forms an alloy without sensibly affecting its properties.

In England, zinc is obtained both from calamine and blende, the principal works being in Bristol. Calamine costs £6 per ton, and blende £3, the ton being considered 2030 lbs.

The following is an estimate of the cost of manufacturing one ton of zinc from calamine—

	£.	s.
3 tons of calamine cost £6 per ton,	18	00
24 tons of coal at 5 shillings per ton,	6	00
1 foreman of the furnace, 6 shillings per day for 7 days, - - -	2	02
2 laborers at 4 shillings, - -	2	16
Sundry expenses,	1	00
	29	18

The zinc sells from £40 to £44 per ton.

Foreign zinc delivered in London, costs from £20 to £24 per ton. Hence the English government fix a duty of 20 per cent. on foreign zinc.

When zinc is obtained from blende, the ore is broken up at the mine in Holywell, into fragments of the size of a filbert, and is sold on the spot at £3 per ton. It is roasted without any further preparation, in a reverberatory furnace. The furnace is eight feet wide and ten feet long. The distance from the vault to the sole is thirty inches, and the altar is eighteen inches high. The ore is spread over the sole of the furnace from four to five inches in thickness, and it is raked over incessantly during the roasting. Four tons of coal are required for the preparation of one ton of roasted ore. About 20 per cent. of sulphur is driven off in the process. The operation continues from ten to twelve hours.

To reduce the zinc from this oxide or roasted ore, they mix one quarter of the roasted blende, one quarter of calcined calamine, and one half of charcoal. The zinc being distilled in a furnace like the one represented in the foregoing figure, amounts to 30 per cent. —*Voyage metallurgique en Angleterre par MM. Dufrenoy & Elie de Beaumont, Tome 2d, p.* 694, *2d ed., Paris,* 1839.

I have ascertained, by actual trial, that the blende of Eaton can be easily wrought for zinc by roasting it, and then mixing it with powdered charcoal and distilling it in a Sturbridge or Hessian clay retort—2000 grains of the blende yielding 777 grains of pure zinc, or 38.8 per cent. It is richer than the English blende above noticed, being remarkably pure.

Two thousand grains of the Shelburne black blende yielded, by similar treatment, 400 grains of pure zinc, or 20 per cent. The Warren black blende yields 30 per cent. of zinc. By roasting 2000 grains of Eaton blende, 1700 grains of oxide of zinc is obtained, and if mixed with granulated copper and charcoal, and melted in a closely covered crucible, will make good brass, the revived zinc combining with the copper to form that alloy. The brass is then to be poured out, and on being re-melted as usual, will be found to be of good quality. The Warren blende may be economically used in the same way, and the copper may be obtained from the copper ore in the mine close by the zinc mine. It is possible to make brass, directly, by mixing the thoroughly roasted copper pyrites with roasted blende and charcoal, and exposing the mixture to a reducing heat in a covered crucible. Although the brass I have made, by this process, was not so fine as that prepared with the copper freed from iron, still, by operating in a large way, and pouring off the alloy, it may perhaps be obtained sufficiently pure for some uses. It does not contain a sufficiency of zinc, and will require an addition of more in re-melting. If a copper furnace is set up in Warren, it will be more profitable to use the metallic copper in cementation with zinc for brass, or the zinc and copper, reduced separately, may be mixed and melted in the proper proportions. Common brass consists of 66 per cent. of copper and 34 per cent. of zinc. That of Stohlberg and Jemmapes, according to Berther, consists of—

	Stohlberg.	Jemmapes.
Copper,	65.8	64.1
Zinc,	31.7	33.6
Lead,	2.2	2.0
Tin,	.3	.3
	100.0	100.0

Yellow metal, used for sheathing ships, is composed of zinc and copper, there being about 60 per cent. of zinc in the alloy. It is rolled, either hot or cold, into thin sheets, and is at present in considerable demand.

Copper.

This valuable metal stands next to iron in its economical value, and is indispensable in the arts. It was known to the ancients, and it is probable that at first only native copper was used, but by degrees the easily reduced ores were wrought by the aid of the forge or furnace. To modern metallurgic art, the reduction of the sulphurets of copper and iron to copper, is due ; no inconsiderable degree of knowledge is necessary for their management, and the ancients had not sufficient chemical skill to reduce an ore requiring so many nice operations.

Carbonate and the red oxide of copper are readily converted into metal by the aid of charcoal, but the sulphurets require preparation, as follows:

When the ore is more or less mixed with other minerals and with the rock, it is first pulverized in the stamping mill. It is next passed to the washing tables, where it is carefully washed and the ores and rock separated, in virtue of their different specific gravities. Copper pyrites has a specific gravity of 4.16, and quartz has a specific gravity of 2.65, and tremolite, a specific gravity of 2.93. Now on washing a mixture of copper pyrites, quartz and tremolite, it is evident that the water will wash away the lighter minerals and leave the copper pyrites quite pure. The specific gravity of blende being 4.05, and that of iron pyrites being 4.83, it will be found impossible to wash them entirely out from copper pyrites. In general, we may say that in all cases where the specific gravities, as thus expressed, differ in a whole number, they may be separated on the washing table, so that each ore may be obtained nearly free from admixture with the other.

The washing table is made by fixing a large plank platform, by suspension with rope or chain slings to two upright posts, and having a trough of water above the board, extending from one post to the other, and allowing the water to flow through small holes in the sides of the trough over the platform, which slopes at a small angle from the trough. In order to effect the operation in a more thorough manner, the washing table is made to vibrate or joggle, by means of a notched cylinder which passes from one part to the other, and is made to rotate by water power. The ore being carried in on wheelbarrows upon the platform, is placed at its upper part, beneath the current of water, and is quickly spread along by the person who tends the board, the flow of water being stopped for the time. Then the water is allowed slowly to run over it, wetting the whole thoroughly, and at length a more full current is allowed to pass over it, the ore being actively worked over by means of a rable or iron rake, with a scraper on the opposite side. All the ore carried down by the water, is shoved back, and the whole worked over until it is clearly washed of its foreign minerals. The waste water passes over a gradual slope to a pit, and much good ore is found in the drain, and is saved. The washed ore is now taken away and drained, when it is ready for the roasting furnace. While the laborer is charging or discharging a table, the washer goes to another washing board placed near by, and worked by the same power, and keeps always at work. The operation is a disagreeable one, for the washer has his feet always wet. He usually wears heavy wooden shoes or clogs. Sometimes, especially when the work is done by women, heavy cowhide boots are worn, so as to protect the feet.*

The ore is thrown upon the sole or hearth of a large reverberatory furnace, and spread evenly, and raked over with the rable, actively, during the first impression of the fire, which now burns with the deep blue flame of sulphur. It is essential that the ore should be constantly stirred, to prevent an agglomeration of the particles, which would exclude the action

*At one of the copper mines in France, I asked a poor girl who spent her days in washing copper ore, how much she was paid per day, and was informed that she worked for 10 sous, (about 10 cents,) per day, and found her own food, clothing and lodging. I asked her what she lived upon, and she said, bread and a soup made of onions and a little salt butter! What would our American girls think of such a life? There are many poor people in Europe, who are glad to do such work at that low price, and hence the products of their industry are afforded so much cheaper than we can generally produce them in this country. Here we must make machinery do most of our work, and when the ores are sufficiently rich and abundant, fair profits may be made and good wages paid to the workmen employed.

of the air, and prevent proper oxidation of the sulphur and the metals. After the first portions of sulphur are expelled, and the surfaces of the particles of ore are covered with a film of oxides of the metals, the fire may be allowed to become more active, and the ore requires less stirring. The heat is ultimately raised to redness, and no more sulphur remaining, the charge of the furnace is withdrawn, and the ore being then mixed by grinding it with charcoal and limestone, or other suitable flux, is carried to another furnace, and reduced to crude copper, which is subsequently refined by re-melting and working it over as usual in a copper refinery by the reverberatory furnace.

Sometimes the ore, after roasting, is reduced directly in a blast furnace, constructed like a cupola iron furnace; and the copper and iron being both reduced to metals, the copper sinks, in virtue of its higher specific gravity, to the bottom of the hearth, while the iron floats upon it, and the slag on that; so that from three different openings in the furnace, at the same time, are flowing streams of molten copper, iron and slag. This beautiful operation is the cheapest method of reducing the roasted copper pyrites, but the copper requires refining to free it from iron, which combines with it in small proportions, forming an alloy. Copper ores are found in several towns in New Hampshire, the most important localities being in Warren, Bath and Unity; while small veins are found in Haverhill, Franconia, Jackson and Shelburne. (See topographical part of this report.)

The Warren vein is of such magnitude as to warrant mining operations.

The pure ore from that locality yields 32 per cent. of copper by assay, and contains 34 per cent. In working the mine, the ore, mixed with the tremolite rock, will be separated by stamping and washing, and the washed ore will yield 27 per cent. of copper, and the rock, just as it is extracted, contains from 6 to 12 per cent.

Assay of Copper ore.

The ore, if copper pyrites, (the most common species,) is to be assayed as follows:

If the ore is pure, it may be pulverized, weighed and operated upon immediately. If not, it is to be washed, a given weight of the ore being taken for the purpose.

The washing is performed in a smooth hard wood trough, by placing the ore near its upper end, wetting it and then running over it a small stream of water, stirring the ore continually during the operation, and keeping the trough gently inclined, and receiving the washings in a bowl. At the close of the operation the heavy ore will be left quite clean, at the upper end of the trough, and may then be removed, dried and weighed. The washings are also to be collected, dried, weighed and examined for copper; and if much is contained, it is to be washed a second time in a bowl. The washed ore is next to be roasted, to expel the sulphur. This is done in a saucer shaped dish, made of refractory clay and old crucible. The heat is to be raised at first slowly, the ore being constantly stirred, to bring the particles in contact with the air, so as to effect oxidation of the sulphur, iron and copper. The heat is ultimately raised to full redness, and the operation is continued so long as the smell of burning sulphur is perceived. The roasted ore is then to be weighed. It is next to be mixed with fine charcoal and carbonate of soda, or potash, and placed in a crucible, lined with lampblack, and covered with a crucible ware cover. Then it is placed in the furnace, and the heat is raised to whiteness, and

after it has been exposed a quarter of an hour to this temperature, it is to be removed and allowed to cool. The copper will be found reduced, and is easily detached from the lamp-black lining of the crucible. It may be weighed, and is then to be refined, by melting it with borax, in a naked crucible, and a button of pure copper will be obtained, which is to be weighed.

If another method is desirable, mix the roasted ore with charcoal, lime and bottle glass, and reduce it in the naked crucible, at the highest temperature of the furnace. A button of copper will be obtained. A little will be lost by combination with the substance of the crucible and with the slag.

Assay by Acids.

Copper pyrites may be assayed by acids, as follows: Take the finely powdered ore, say 100 grains weight; put it in a glass flask, and pour upon it, little by little, a mixture of nitro-muriatic acid, and digest at a boiling heat, until it entirely dissolves; boil it until the nitric acid is expelled, which may be known by the color of the chloride remaining. Dilute the solution with water, and filter it. Then put into the solution a plate of polished iron or steel, the latter being preferable, (bright saw plate or a case knife will answer;) leave it until all the copper is precipitated, which will be ascertained by plunging a clean piece of steel into the solution, and observing that no more copper is precipitated upon it. Pour off the solution, and pour upon the precipitated copper a quantity of alcohol, and wash the metal; scrape off all the copper from the steel plate and remove it. Then collect the copper on a filter, dry it quickly and weigh the copper. It will give the per centage of copper in the ore.

Analysis of copper pyrites.

An analysis of copper pyrites is more complicated, and requires a degree of practical knowledge of chemistry, which is not to be expected out of the profession.

The process is as follows:—Take 25 grains of the finely powdered ore; digest it in pure fuming nitric acid, until all the sulphur is oxidated. Dilute, filter and wash. The filters must be of fine India paper, double, and of equal weight. Dry, burn and weigh one against the other. The difference is the insoluble matter, (probably silex.) Test it and ascertain its nature. To determine the quantity of sulphur in the solution, precipitate the sulphuric acid by a solution of chloride of barium, in slight excess. Sulphate of barytes will be precipitated as a white powder. Collect it on double counterpoised filters; wash thoroughly with water; dry and separate the filters; burn and weigh one against the other. The difference of weight is sulphate of baryta, from which calculate the quantity of sulphur contained, which is 13.797 per cent.

Clear the filtered solution of barytes, by dilute sulphuric acid in slight excess, filter and wash. Take the solution and add to it an excess of aqueous solution of pure ammonia. The oxide of iron will be thrown down as a bulky brown precipitate, which collect on a filter, wash thoroughly, dry, ignite in a platina crucible, and weigh. It is peroxide of iron, from which calculate the metallic iron, which is 69.338 per cent.

The oxide of copper is in the solution still. Boil it to expel the excess of ammonia. Then, while boiling hot, add a boiling solution of pure potash, in great excess, and boil until all the copper is thrown down, as a black precipitate, and the solution above is colorless. Collect the deutoxide of copper on double filters, wash with hot water, dry, ignite in platina, and weigh, placing the ashes of the outer filter in the weight pan. The difference of weight is that of the deutoxide of copper, from which calculate the quantity of metal, which is 79.826 per cent.

This completes the analysis. Add up all the products, and if the work has been well executed, the sum will be equal to that of the substance operated upon. If desirable, the deutoxide of copper may then be reduced to pure copper, by heating it to redness in a glass tube, in an atmosphere of dry hydrogen gas, prepared by passing the gas over fused chloride of calcium. By this process not a particle is lost, and the truth of its composition as above stated may be proved.

Although this is one of the easiest analyses we have performed, still, few will be disposed to repeat it, for want of apparatus and pure chemical reagents. It is given because some teachers in the Academies may be disposed to exhibit an analysis to their pupils, and they are most likely to have the requisite materials for the performance of the work.

Copper may also be precipitated from its solution in acids or ammonia, by the action of galvanic electricity, making use of the electrotype process and Daniels' constant battery. The copper is obtained in a solid plate, on any metal used in connection with the pole, from the zinc plate, of the battery. If iron is used for the plate, the solution must be made ammoniacal, and if silver or copper is used, it should be neutral. The exact form of any coin or medal may be copied by this process. It is, however, very slow, requiring weeks for its completion.

Analysis of a mixture of copper pyrites and tremolite rock from Warren copper mine. The specimen is supposed to represent the fair average of the ore as extracted in 1841.

Tremolite, - - - -	55.30
Iron, - - - -	15.72
Copper, - - - -	11.97
Sulphur and loss, - - -	17.01
	100.00

The pure compact copper pyrites, such as is obtained from the solid veins, will contain, according to the analysis of a pure specimen by Rose—

Copper, - - - - -	34.40
Iron, - - - - - -	30.47
Sulphur, - - - - -	35.87
	100.74

Or 2 atoms of sulphur combined with 1 atom of iron and 1 atom of copper, the mineralogical formula being $Fe.\ Cu.\ Su^2$.

100 grains of copper pyrites from H. Lang's estate in Bath, yielded, on analysis—

	No. 1.	*No.* 2.
Copper,	32.5	31.92
Iron,	33.0	31.64
Sulphur,	31.2	27.24
Silex,	3.2	9.20
Loss,	.1	.00
	100.0	100.00

A specimen from Williams' mine, in Bath, yielded in 100 grains—

Copper,	2.6
Iron,	26.6
Sulphur,	36.0
Silex,	33.2
Alumina,	1.6
	100.0

An average specimen from James Neal's estate, in Unity, yielded on 100 grains—

Sulphur,	32.575
Copper,	6.345
Iron,	42.780
Titaniferous iron,	18.300
	100.000

100 grains of copper and iron pyrites from S. Kempton's, Croydon mountains, contained—

Siliceous matter,	7.80
Iron,	35.66
Copper,	3.18
Alumina,	1.80
Sulphur,	46.38
Manganese,	6.46
	101.28
Gain,	1.28
	100.00

Lead.

Galena, or sulphuret of lead, occurs in numerous localities in New Hampshire, but there are but very few veins of sufficient magnitude to prove of economical value, while lead is sold at its present rate.

All the lead ores which I have discovered in the State, are rich enough in silver to be advantageously wrought for that metal, if an adequate supply of the ore can be obtained. There are two localities which will furnish a sufficient supply for a furnace; they are in

Eaton and Shelburne. At the former place, the lead ore will be saved while extracting the zinc ore, and when a sufficient quantity is accumulated, it may be reduced in a reverberatory furnace to lead. The furnace used for roasting the zinc ore, might temporarily be employed in the reduction of the lead ore. After its reduction to the metallic state, the silver may be separated from the lead by the new process of crystalizing out the lead, leaving a rich argentiferous alloy, which on being poured off and again fused and crystalized, and the liquid alloy again poured off, the latter may be cupelled for silver in the bone ash cupel, and a button of pure silver obtained, after oxidation of the lead.*

The Eaton lead ore, on cupellation, yielded in 2000 grains, 2 grains of pure silver, equal to two pounds to the ton. If litharge is wanted, the lead may be converted into that oxide, and cupellation will finish the purification of the silver.

The lead ore is the smallest part of the lode of the Eaton vein, and does not average more than eight inches in width, while the blende or zinc ore is five feet wide.

If wrought for lead, the pure galena will yield, in the large way, 79 per cent. of that metal. It contains 85 per cent., but galena being volatile, a portion of the ore is always lost by sublimation, and is carried off by the draught; and some is lost in the slag.

The argentiferous galena of Shelburne is still richer in silver, and will yield three pounds of silver to the ton of ore.

By assay, I obtained from 2000 grains of this ore, the following result: 1680 grains of lead=84 per cent., which, on cupellation, yielded three grains of fine silver, or three pounds to the ton of ore. On assaying and cupellation, crystaline and the fine grained or granular galena from this locality, was found to yield the same proportions of lead and silver. This variety of ore is generally supposed to be more argentiferous than the crystalized variety.

Although the veins of argentiferous galena in Shelburne are not more than from two and a half to six inches wide, so far as they have yet been opened, still, since they have evidently proved wider, as the operations extended downward in mining, there is a prospect that they will ultimately prove valuable. At present, miners may earn fair wages in extracting the ore. (For a description of the locality and for a plan of the vein, see page 103 of this report.)

Galena containing silver, occurs assimilated with the zinc ore of Warren, but no regular vein has yet been discovered, the galena being disseminated in bunches and groups of crystals in the black blende.

Analysis of lead ore from Warren—pure crystals—200 grains ore yielded—

			Per cent.	
244.5 grains sulph. lead=	166.96	grains lead,	83.48	
	2	grains silver,	2	
	167.16		83.68	
	32.84	sulphur,	16.32	sulphur.
	200.00		100.00	

* See a detailed description of this process farther on.

Argentiferous galena is found in small veins in Bath, Haverhill, Epsom, Nashua, Lyndeborough, Dunbarton, Tamworth, Sandwich and many other towns; but none of the veins which I have examined, were of sufficient magnitude to be worked economically for the metal. (See the topographical part of this report for descriptions of the localities.) The narrowest veins of galena are generally most highly charged with sulphuret of silver, a fact which I have long since proved by analyses of the ores found in our New England primary rocks; and occasionally I have found narrow veins of argentiferous galena, which yielded 7 pounds of silver to the ton of ore.

Reduction of lead cupellings for silver.

Lead is reduced, in the large way, by various kinds of furnaces, the rudest sort being used by the lead miners of the Western States, while the European finds it necessary to have the best reverberatory furnaces, in order to obtain the largest possible yield of metal. This improved method is now gradually obtaining in the west, and will ultimately supersede the rough contrivances of the early smelters.

Lead is always obtained, in the large way, from the sulphuret, which is its only abundant ore.

The sulphur is removed from the metal by a gradual roasting, by which it is converted into sulphurous acid, and escapes by the chimney. The metal is then melted and kept exposed to the action of the air, long enough to deprive it of any remaining sulphur. It is then run off into large iron pots, calculated to retain it until a sufficiency is obtained for casting into pigs or ingots.

It is one of the easiest ores to reduce, and but little skill is required in obtaining the metal; but the profits of a furnace depend on the workmen being able to obtain the largest possible quantity of metal from the ore. Hence the old scoriæ, or cinders, are always worked over a second time, and a quantity of metal is obtained from them.

Sulphuret of lead is easily assayed in a cast iron crucible, by mixing it with twice its weight of dry carbonate of soda or pearlash, and melting it, at a dull red heat, so that the iron of the crucible may take the sulphur from the fused alkaline sulphuret of lead. The operation being completed, the crucible is to be withdrawn from the furnace and the lead poured into an ingot mould. Nearly all the lead contained in the ore, is at once obtained by this process, and a crucible, with care, will answer for several operations, which may rapidly follow each other without allowing the crucible to cool.

To separate the silver from lead requires more skill and experience. In assaying, it is best done in a fine bone ash cupel, previously heated to redness in a fireclay muffle, and then the lead, containing silver, being laid in it, speedily melts, and by the current of air drawing through the muffle, the lead is oxidated, melts, and is absorbed as litharge, by the bone ash of the cupel; when, at the close of the operation, a brilliant globule of silver remains in the bottom of the muffle, and is known to be pure by the flash of light which is seen at the end of the operation, this flash signifying that the surface of the metal is no longer oxidated. The cupel is now removed and allowed to cool. The little button of silver soon crystalizes and throws out a quantity of sprigs of the metal, which project through the indurated crust.

Tin.

This metal was well known to the ancients, and was one of the first metals exported from England, where the ore was found in the state of small, water worn pebbles, in the alluvion of rivulets, and hence was called stream tin. This ore is still wrought in Cornwall, and produces the purest metal. It was subsequently found in veins in the granite and metamorphic slates, called by the miners, killas. The ore was originally smelted by means of charcoal, but at present, bituminous coal is used instead, and is found to be a much cheaper fuel, since charcoal, from the scarcity of wood, is now very expensive. Veins of tin ore are generally narrow, and are considered workable, at a profit, when they are three inches wide, and even narrower ones are wrought advantageously when they occur near each other, so as to be readily attacked by the miners in a shaft or level. The following paragraph is extracted from a treatise on manufactures in metal, London, 1834, Vol. 3, p. 9.

"The tin ores of Cornwall are found in veins, or fissures, locally called *lodes;* and the direction of these fissures is mostly east and west. In this manner they frequently pass through a considerable tract of country, with very few variations, unless interrupted by some intervening cause. But, besides this east and west direction, there is what the miners call the underlying or *hade* of the vein, which is a deflection of the lode from the perpendicular line. This slope generally trends north or south, but its direction is by no means uniform, for it will frequently underlie a small space in different ways, appearing as though it had been forced to either side. Sometimes the deviations of the lodes are wavy, making large curves where they cross a valley; and in almost all cases the lesser veins branch from the great lodes, like the boughs of a tree, the ramifications diminishing as they extend in distance, till they terminate in threads.

These veins sometimes cross each other horizontally, or in their perpendicular descent, when they are called *contras* by the miners; sometimes, too, a promising vein will suddenly disappear, without giving any warning, by becoming narrower or of worse quality; this occurrence is called by the workmen a start, and is no uncommon thing in the Cornish mines. Thus, in a single day, a rich vein of tin may suddenly terminate, and leave the miner no clue by which to proceed in his attempts to re-discover the infracted stratum."

The stream furnishes a still more uncertain supply, some deposits being very rich for a while, and then are suddenly exhausted. Not only are the streams turned from their channels, in order to obtain the ore deposited in its bed, but the water is also conducted over the soil for the purpose of washing out the earth and exposing the tin ore. Veins of porphyry, containing this mineral, have also been wrought beneath the sea by running a level from a deep shaft on the land, so that the rumbling of the sea waves and the chafing of the rocks moved by them, could be heard with fearful distinctness.

One of the most remarkable mines of this class is that of Huel Cok, in the parish of St. Just, where, from a shaft 80 fathoms deep, a level runs horizontally quite to low water mark.

Another "still more singular work of this kind was executed more than a century ago, in the midst of the sea, near the port of Penzance."

Two hundred yards from the shore, where tin ores were known to exist, a mine was opened by making a curb, or coffer dam, to keep out the water, and then sinking a pit in the bottom until the ore was reached and extracted, by making a gallery and digging out the rock and ore, which was carried to the bottom of the pit, and then hoisted out and transported to the shore in boats. This mine was injured, if not rendered worthless, by a vessel drifting against the curb and breaking it down, so as to admit the waters of the sea.

From the above examples we may learn that in Europe tin ores are not raised, without persevering labor and great expense.

Tin ores are also found in Bohemia, Saxony, Greenland, Sweden; also in Cochin—China, Malacca and Banca, in the East Indies.

Most of the tin brought to the United States, comes from the two last mentioned localities; the English and German tin being, in a great measure, consumed in the countries where it is found, or is converted into tinned iron and britannia ware for domestic use and exportation.

France has no tin mines that can be profitably wrought, and depends on England for her supply.

Tin ore, as before observed, was unknown in the United States anterior to its discovery in the town of Jackson, (p. 80, 139 *et seq.;*) and although only four or five small but rich veins have, thus far, been discovered, still the occurrence of these veins is regarded as an important fact in science, and as one which will not fail to encourage a more careful and extended search. Specimens of the ore may now be readily obtained, to be used for comparison, by those who may seek for veins elsewhere in the State. It is to be hoped that the time is not far distant, when we shall see American tin in the market. It appears, from my researches, that even the limited deposits I have discovered, may be wrought at a moderate profit; and since it is probable that mining operations will disclose new veins and dilations of those already discovered, which have not yet been sufficiently opened, and never have been mined at the crossings, there is every probability of finding a sufficiency of the ore for the economical manufacture of block tin.

Smelting of Tin ores.

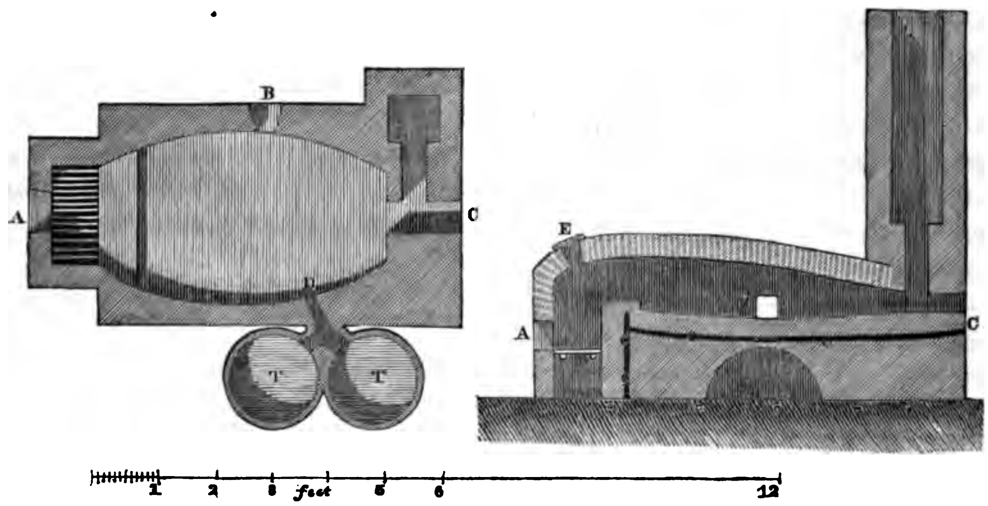
There are but two ores of tin known; viz., the sulphuret and the oxide. The latter is the only tin ore economically wrought, for the sulphuret is a comparatively rare mineral.

The reduction of oxide of tin is effected at a full red or forge heat, by the aid of charcoal alone; but since a small quantity of foreign matters occurs with the ores, it is proper to make use of a small quantity of lime to flux them, and effect their separation from the metal.

When the ore contains any mixture of arsenical or sulphureted minerals, it is first roasted in order to expel the sulphur and arsenic. Then the roasted ore is mixed with charcoal, and thrown into a reverberatory furnace; the furnace doors being closed, the whole mass is raised quickly to a pale red heat, and the tin will then be found reduced to metal. The whole mass is then well raked over with a rable, or iron rake, the scoriæ are drawn out at the door of the furnace, and a few shovels full of dry slaked lime are quickly spread

over the melted metal. The lime takes up and combines with the siliceous and ferruginous matters, forming a stiff slag, and this is withdrawn by the rable. Then the tin is run off by opening the tymp of mortar, and the metal flows into iron kettles placed beside the furnace for this purpose.

The following drawing will serve to give an idea of the tin furnaces used at St. Anstel, in England, and is extracted from the *Voyage Metallurgique en Angleterre par MM. Elie de Beaumont et Dufrenoy.*



Plan of a new furnace for the reduction and refining of Tin.

A, door for the fuel, (coal being used in England.)

B, door for charging the furnace with tin ore and coal.

C, working door.

D, tap hole for draining off the melted tin into the pots. This hole is closed by clay while the furnace is at work in the reduction of the ore.

E, hole, opened while charging the furnace with the fire, ore and coal, in order to prevent the fine particles from being swept up the chimney by draught.

c, c, c, c, little canal for ventilation, by a current of cold air which cools the sole of the furnace, and thus prevents it from being rapidly destroyed by heat.

T, T, reception pots, into which the reduced and melted tin flows.

The chimney is from 34 to 50 feet high. Its internal diameter is 20 inches.

In this furnace, coal is used for fuel, and where wood is substituted, the fireplace would have to be modified accordingly, so as to receive long wood.

Charcoal and wood fuel produce the finest tin, since they are free from sulphur.

In England, where tin is reduced by means of charcoal, it is usual to make use of a kind of blast furnace which swells out boldly in the middle, receives two blast pipes just above the hearth, through a single tuyere, and has a large and deep crucible to contain the reduced metal. The establishment is called a blowing house, and is devoted exclusively to the production of the finest grain tin, from the stream ore. A less per centage of metal is obtained at the blowing than at the reverberatory furnaces. Kiln dried fuel answers

perfectly well for the reduction of tin ore in a reverberatory furnace, and will be used if the mines of Jackson prove rich enough to work in the large way.

Refining of Tin.

Tin is seldom obtained absolutely pure by the first operation of reduction, on account of the other metals which occur associated with its ores, and are reduced with it, forming an alloy. The foreign metals are generally arsenic, iron, copper and antimony. The latter is not found associated with the Jackson ore, and therefore no precautions are required respecting it.

The arsenic is mostly removed by previously roasting the ore, but still some traces will remain, if the ore contained any considerable admixture of it. The compact tin stone which forms the small veins, is free from arsenical compounds, and contains but a trace of oxide of iron; so that nearly pure tin will be obtained in the first assay. In working the large north and south vein, where the oxide of tin is in a crystalized state, all the usual precautions in getting rid of the admixtures of the above named foreign matters, will be required. The ore is then first to be roasted thoroughly, then mixed with charcoal and reduced by a heat, quickly raised to full redness, and kept up until the oxide of tin is reduced to metal. The whole is then to be raked over, and a small quantity of slaked lime is thrown upon the surface, and it is again raked. The slag being separated, the metal is run off into the kettles by opening the tap hole, and in the kettle it is to be kept melted by a small fire beneath it. It is then stirred with a green wood pole, which causes a rapid bubbling, and a scum rises, which is to be removed. The purest tin occupies the upper part, and is to be removed by ladles and cast into pigs. The rest is cast into blocks of large size, and they are subsequently refined by liquation. The dross skimmed from the pot, is also reduced, with all the grains of tin that can be separated from the slag by the stamping mill. In refining, a large number of the blocks of impure tin are placed near the altar of the reverberatory furnace, and the heat is raised slowly until the pure tin melts and runs out by liquation, and flows to the opposite end of the furnace, where it is drawn off into kettles and stirred with a green wood stick, and then cast into pigs.

A quantity of an alloy of tin, iron and copper remains in the furnace, and is subsequently reduced with various other refuse matters; and a quantity of impure block tin is obtained from it.

Assay of Tin ores.

It may prove useful to those who are in search of tin ores, to learn the method of assaying the ores for the metal. If merely a minute quantity of it is required for the purpose of proving the ore to be tin, an assay by means of the blowpipe is amply sufficient; but if an ingot of the metal is wanted, then the assay is to be made in the crucible.

In order to make a good blowpipe assay, the operator must of course understand how to use that instrument in an efficient manner. Allowing that he understands the operation, then the following is the method of determining the presence of tin. Take a few grains of the supposed tin ore, crush it to fine powder, roast it and mix it with its bulk of fine

charcoal; then add twice its bulk of carbonate of soda, and half its bulk of glass of borax, and make the whole mass into little balls about the size of pepper corns, moistening it, so that it can be rolled up in this manner. Take a piece of good sound charcoal, (that of some light wood being best,) make a hemispherical cavity in it, and place the little balls in it; melt them at the end of blue flame, before the blowpipe, and covering it with a piece of charcoal, urge the heat until entire reduction is effected and the metal has settled into a bright globule. Since the borax glass covers the metal, it will not oxidate while cooling. When cold, it is to be removed, and when placed between the teeth, a distinct crackling of tin will be felt on biting it. It is very malleable and white. This will lead to the belief that it is tin; but in order to prove it, place it in a little capsule of glass, and pour upon it some nitric acid, and warm it. Rapid action will take place, and the oxide of tin, as it forms, will subside as a white powder. Evaporate to dryness, and then dissolve whatever water will take up. All the tin is left in the state of a peroxide or stannic acid, insoluble in all acids. This is an absolute proof that the metal is tin.

The borax glass contains all the other metals, which were originally mixed with the tin ore, and may be separated from it by chemical tests.

Each of the little globules prepared for the blowpipe, may be successively reduced, and all the tin may be ultimately obtained in a single globule.

Assay in the Crucible.

This may be effected in an ordinary forge fire, or in a lined furnace 10 inches square by 20 inches high, and having a good draught.

Preparation of the crucible. A Hessian crucible is to be rammed full of lampblack, adding a little at a time, and pounding it down solidly; then with a putty knife scoop out the middle of the mass of lampblack, leaving a crust about a quarter of an inch thick on its bottom and around its sides; then with a smooth glass rod, or burnisher, polish the inner surface until it is smooth and brilliant.

The crucible being prepared, the ore, if impure, is to be pulverized, washed and roasted; and is then to be weighed and mixed with one half its bulk of lampblack or fine charcoal. It is now ready and may be packed into the crucible, which is to be covered and placed in the forge or furnace. The heat is then to be raised as rapidly as the crucible will bear, to a white heat. On pouring out its contents after this operation, it will be found that the oxide of tin is completely reduced to metal. If the ore was pure, all the product is fine tin; but if the metal, on trial, is brittle, it must be mixed with a little carbonate of soda, or potash, and glass of borax, and be melted again at a red heat in a naked Hessian crucible. The metal will then be nearly pure, and is malleable. To refine it, melt it again in a clean iron ladle and stir it with a green stick, and then pour it into an ingot mould, taking care not to pour until the metal has cooled sufficiently to allow the alloys to harden, when only pure tin will run from the ladle into the mould. A skimmer of wood should be used in pouring, to keep back the dross.

By following these directions, any one who will take the pains, may make a good assay of tin ore, and the work can be very conveniently performed in a blacksmith's shop. Any

silversmith can furnish the Hessian crucibles, or they may be obtained at most of the hardware shops of Boston.

Assay of Jackson Tin ore.

By assaying as above described, I obtained, from the compact tin ore of Jackson, 73 per cent. of tin, the pure ore containing 76 per cent.

The crystaline mixed ore yielded from 30 to 50 per cent., according to its purity; and the rock bordering on the tin veins, yielded from 2 to 12 per cent.

100 grains of compact tin ore was placed in a brasqued crucible and melted; 73 grains of impure tin or 66 grains of fine tin resulted; after refining, 62 grains of pure malleable tin were obtained.

5 ounces of fragments of the ore yielded 3 oz. of tin.

3000 grains of refuse fragments of tin ore from William Eastman's new vein, were digested in nitric acid, to remove the iron, arsenic and copper, which might be mixed with it.

From 3000 grains

2585 grains were obtained, leaving

415 grains soluble impurities, or 14 per cent. nearly.

2585 grains gave 1490 grains of impure tin, obtained by reduction with lampblack.

1390 grains of tin remained, when purified=46.3 per cent.

11,750 grains of wash tin ore were digested in acid and then washed clean; some mica separated in white silvery scales, and the ore was reduced in weight to 10,400 grains; loss, 1,350 grains=8.7 per cent. soluble impurities and mica, and it still contains much quartz in coarse particles Assayed in a brasqued charcoal crucible alone, the tin was reduced to a button, and grains of metal mixed with yellow glass, were formed of the mica quartz and oxide of tin. This was fused with one half its weight of carbonate of soda. Tin obtained, re-melted and cast, weighed 11 oz. 5 dr. Refined the tin by re-melting, to separate the iron and the scoriæ; 10 oz. 4½ dr. of tin were obtained, which was perfectly fine, soft, and malleable into the thinnest sheets.

The average of a lot weighing 100 pounds, obtained by two men in two days, was from 35 to 40 per cent. A lot of small ore, weighing 22 ounces, was operated upon at once, and yielded 11½ ounces of fine tin, which was cast into a flat ingot, one half of which was sent to the National Institute at Washington, and the other was placed in the cabinet in the State House, at Concord, with specimens of the ore from which it was obtained.

When it is desirable to avoid the loss occasioned by washing the ore, it may be completely purified by pulverizing it, and pouring upon it a sufficiency of strong nitro-muriatic acid to cover the ore; and then, on exposure to a boiling heat, all the metallic oxides and sulphurets will be removed, and the oxide of tin will be left quite pure, or mixed only with a little quartz. It is then to be rinsed clean with hot water and dried. In this state it will yield fine tin by a single operation in the lined crucible, and there will be no loss, unless quartz is present, when a little of the oxide of tin will combine with it. This is prevent-

ed by mixing a sufficiency of pearlash with the ore to take up the quartz and form glass, while the carbon reduces the oxide in the silicate to metal.

Uses of Tin.

This metal is so well known under the names of block tin, grain tin and tin foil, as to render it unnecessary to dwell long on its uses. It is best known in the state of tin plated iron, which, in common language, is called tin, though it is really only iron covered with a thin layer of that metal.

Tinned iron is manufactured chiefly in Cornwall, in England, where the best kind is prepared. The operation is very simple, but requires dexterous workmen to perform it neatly. The iron is first rolled into sheets, and then scaled by placing them in a reverberatory flame, the sheets being bent so that the fire plays evenly on both surfaces of the sheets. They are then scoured with sand and sulphuric acid, or pickled, as it is called, in muriatic acid and water. When bright, the sheets are covered with muriate of ammonia, (sal ammoniac,) and dipped into a bath of melted tin, covered with greasy or resinous matters. The sheet is then withdrawn and set up edgewise to drain. The tin covers the surface of the iron and penetrates into it, so that the surface is really an alloy of iron and tin.

This valuable plated metal is highly appreciated in all parts of the world, on account of its beauty, cleanness, lightness and freedom from liability to corrode from the action of water or food.

Block tin and pewter are also used for cooking utensils, but have been, in a great measure, superseded by another alloy of tin, called britannia ware, which is composed of—

Tin, - - - - -	100	pounds,
Antimony, - - - - -	28	"
Copper, - - - - -	8	"
Brass, - - - - - -	8	"
	144	

This alloy is more brilliant than pewter, and closely resembles silver in appearance, when well polished. It is well known as a part of the tea table service.

Tin is also used extensively in plating the surface of copper, and prevents its corrosion and preserves food cooked in copper vessels, from the poisonous influence of the oxide and salts of that metal. It is also employed in washing or plating lead pipe used for aqueducts.

In combination with copper it forms bell metal, gun metal and a great variety of articles known as bronze.

This alloy was well known to the ancients, and the implements used in the arts and in war, anterior to the discovery of iron, were generally made of copper and tin. The ancient Egyptians, as before mentioned, made the tools which they used in sculpturing their hieroglyphics, of a very hard alloy of these metals. Although iron is found amid the ruins of Pompeii and Herculaneum, still the principal metallic utensils of household use were made of bronze.

The Chinese gong is an alloy of copper and tin, containing about 20 per cent. of the latter metal.

So numerous and varied are the uses of tin, that it is highly desirable to discover other mines of the ore in this country, and the first step already taken in New Hampshire having proved successful, it is to be hoped that constant vigilance will ultimately be rewarded by the discovery of new veins of this ore. It will be found only in the primary and metamorphic series of rocks; and hence there are well known limits within which it may be expected.

Antimony.

This metal is of a deeper bluish tint than tin, and is highly crystaline and brittle. It is known in commerce under the name of regulus of antimony. Its ore is a sulphuret, containing 26 parts of sulphur and 74 of antimony. For a more full description of this and other ores of antimony, see books on mineralogy.

It is extensively used in the arts, and in medicine. From its giving greater hardness to tin and lead, and on account of its crystaline tendency on cooling, it is admirably adapted to casting, since it swells on cooling and perfectly fills the mould, and thereby takes a more perfect impression; hence it constitutes the basis of type metal and of metal for stereotype plates.

The purest antimony is extracted from its sulphuret, in Auvergne, in Central France, where the method pursued is kept secret. It is also obtained from Germany in considerable quantities. Cargoes of the ore have been brought to the United States from Borneo, in the East Indies, and the ore has been successfully reduced in Boston, and fine regulus of antimony obtained from it.

The existence of antimony ore in the United States was unknown until 1836, when specimens of it were found in Carmel, Maine, and given to me for analysis by Dr. Jewett of Bangor. Since that time I have received a quantity of the ore from Mr. Wm. V. Read of that town.* It occurs in a quartz gangue, in hard blue clay slate rocks, but I have not yet learned whether it is found in a regular and continuous vein. Ores of antimony have also been found in Cornish, and it is probable that the specimen of sulphuret of antimony, copper and silver, previously described, was obtained in the vicinity of that town. It was found somewhere in New Hampshire, but its locality could not be ascertained subsequent to the analysis of this specimen. I found a great number of fragments of antimonial ore in the hands of citizens of the town of Cornish, where I supposed, from the resemblance of the rocks to the ore in my possession, the mineral was probably found. For details of our explorations in Cornish, see page 156 of this report.

Small fragments and crystals of sulphuret of antimony have since been discovered by Prof. Hubbard, in the town of Lyme, near Holt's tavern. The ore was found in masses of quartz, which came from the hill side, but we do not yet know whether any regular vein exists there.

Antimony ore is a little darker colored than the reguline metal, and resembles the sulphu-

* It has been analyzed by Mr. A. A. Hayes of Roxbury, Mass.

ret of antimony of the shops, excepting that the native mineral presents itself generally in wider blades, and is frequently associated with quartz.

Before the blowpipe, it evaporates in the form of a white smoke, which condenses on the surrounding charcoal, and is oxide of antimony, or antimonic acid. During this combustion, the odor of burning sulphur is perceived.

Search should be made in both the above mentioned towns, for veins of antimonial ores; especially for that containing silver; for an ore like that supposed to have been found in Cornish, is worth $192 per cubic foot for the silver alone, while the copper and antimony are also of considerable value.

Sulphuret of antimony is readily reduced to metallic antimony by the action of iron filings or turnings, at a red heat, the sulphur leaving the antimony and combining with the iron, while the antimony separates by liquation, and may be poured off into ingot moulds.

The metal may be run off from the sulphuret of iron, by melting it in a perforated crucible, allowing the regulus or fine metal to liquate through the opening, into another larger crucible placed below to receive it.

Silver.

The appearance of this metal in its alloyed state, as seen in ordinary coin, is well known. When pure, it is of a much whiter color, and is softer, so that it is very flexible, and is easily cut with the knife. In nature, silver occurs in a variety of forms and combinations. Native silver is found mostly in ancient or transition limestones, which have undergone metamorphosis by heat. It is found in crystals, bunches, plates, and long and delicate filaments in the rocks. Masses of solid silver, of several pounds weight, are occasionally obtained by mining, but more generally it is found in scattered particles, in veins of limestone and hornstone in the rocks. The next ore in richness is the chloride of silver. In its native state it occurs in grey or black masses, which cut by the knife like horn; and hence the ore is called horn silver. It contains 75 per cent. of metallic silver, combined with 25 per cent. of chlorine. It is found in Mexico, Peru, Chili, and in Siberia.

These are rich and rare ores; the more common are the antimonial sulphuret of copper and silver, and argentiferous galena or sulphuret of lead, containing sulphuret of silver, which replaces a portion of the sulphuret of lead.

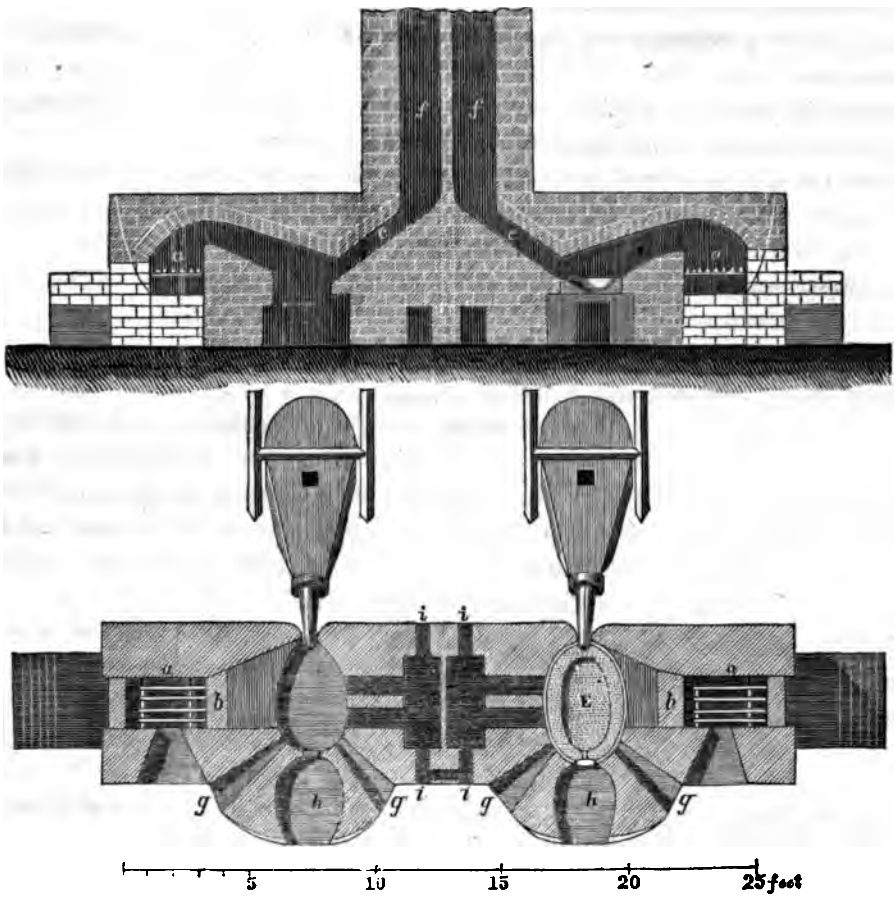
Nearly all the lead ores of New Hampshire contain a sufficiency of silver, to give a profit on its extraction from the reduced lead. The richness of the veins generally increase in proportion to the diminution of their magnitude; some of the smallest veins containing ten times as much silver as the wide ones. The new method of crystalizing the lead and skimming out the crystals free from, or containing but little silver, and thus augmenting the richness of the remaining alloy, so as to save expense in cupelling, will render it easy and economical to separate the silver from any New Hampshire lead ores that may be wrought. This process has not yet been employed in this country, and I would call the attention of metallurgists to it as one that may prove of value.

None of the lead ores of Missouri, which I have analyzed, yield any silver, nor do those of Wisconsin and Iowa contain the slightest trace; hence it is erroneous to suppose that

all galena contains silver. It appears to be confined exclusively to the galenas of the primary and metamorphic rocks.

The following is a section and plan of a cupelling furnace used in the separation of lead and silver in England. (*Voyage Metallurgique en Angleterre, Tome II., Atlas pl. XVI., Fig's* 1 *and* 2.)

Vertical section of the double Furnace.



Plan.

c, flue to the chimney; *f*, chimney. In the plan below are seen the bellows used for blowing off the litharge into the basins, *h h*.

a, grate and fireplace; *b*, bridge of the fireplace; E, cupel. It is movable, and is fixed in an oval frame of iron, having a border. Its bottom is supported by four transverse bars of iron. In forming the cupel, this frame is filled with a finely powdered mixture of bone ashes, and the ashes of ferns, which are put in alternating layers and beaten down hard by means of a mallet, and then a shallow cavity is dug out to receive the lead. *g g*, openings for the introduction of lead and for drawing it off; *h h*, basins to receive the litharge.

In New Hampshire, the Eaton and Shelburne lead ores contain a sufficiency of silver, to warrant their being wrought for that metal by the process before noticed. Some other smaller veins, described in the topographical section of this report, may, perhaps, prove worthy of being wrought, but few of them are sufficiently extensive for large works. When extracting the zinc ores of Warren, a considerable quantity of galena may be saved, and should be reduced to lead, and subsequently be wrought for silver. The process is simply to let the metallic alloy cool, until crystals of lead form, when they are to be removed by a skimmer and thrown into separate parcels. The first taken out will be free from silver, while the proportions will increase in each lot withdrawn. The alloy which remains, when rich enough, is to be passed into the cupel, and the process of skimming is to be renewed on the remaining alloy next in richness.

In cupelling on a mixture of peat ash and bone ash, the bellows drives the litharge over the side of the cupel; it melts and runs out by a gutter, and is saved and reduced back to pure lead, by means of charcoal, in the reverberatory furnace.

The silver remains in the cupel, and at the close of the operation is chilled quickly by water, and withdrawn and cupelled anew to purify it from the last traces of lead. Thus, all the silver contained in a ton of lead, is obtained in a solid mass, and is quite pure, while most of the lead has been saved.

The lead ore of Eaton contains 2 pounds, and that of Shelburne 3 pounds of silver to the ton. Hence the ore is worth from 40 to 60 dollars per ton for the silver, while it also yields 70 per cent. of lead, in the large way, and is worth, at 3 cts. per lb., 42 dollars per ton. The silver is then worth nearly as much as the lead in the Eaton, and $18 more per ton than the lead in the Shelburne ore. This fact appears to have been overlooked by those who once contemplated working these mines.

Antimonial silver ores are to be treated as follows: roast them until all fumes of antimony cease; then alloy them with lead, and cupel until all the copper, iron and traces of antimony are carried off, by the solvent power of the litharge, into the cupel. A button of bright silver will remain, and may be separated. This is the process by which the assay of the specimen of antimonial sulphuret of silver and copper from New Hampshire was made, and the results proved as satisfactory as those obtained by a long and tedious analysis, previously performed in determining the true composition of the ore.

Gold.

Although minute quantities of native gold have been found in the brown pyrites of Canaan and Grafton, contained in that mineral exactly like a deposit of the kind in the gold mines of the Ural mountains, still I apprehend that any one who should undertake to extract the gold with a view to profit, would suffer disappointment. The researches which I have made on those ores, have been exceedingly troublesome and expensive, and but two minute spangles of gold were obtained from 2000 grains of the ore.

Many lots of the ore, from both places, were operated upon, and several weeks of time expended in order to settle, definitively, whether the mines were worth working or not. The result, to my own satisfaction, proved the negative. It was, nevertheless, necessary to de-

cide the point absolutely; for the announcement of the discovery of gold might have led others to expect too much. I therefore merely place it on the list of metals found in the State, in very minute quantities.

Many of the striated brown pyrites will be found to contain minute proportions of gold, but I doubt if ever the Siberian mines would prove of any value to the citizens of New England, where labor is worth so much more than in that country.

According to M. Elie De Beaumont, (*Coup d'oeil sur les Mines*) the brown pyrites wrought for gold in Beresof, in the Ural mountains, contains 0.00005 of native gold; and yet the ore is wrought for it.

The speculation in the gold mines of the southern states, in this country, has, by the almost universal failures consequent thereon, demonstrated to our people that gold is one of the least productive metals.

Assay of Gold ores.

Few ores of gold contain visible particles of the metal; but when they do exist, they may be picked out and pressed in an agate mortar, or between two polished pieces of steel, when, if of gold color, and very malleable, they are probably metallic gold. Additional conviction is obtained by boiling these particles in pure nitric acid, which will dissolve them, if they are not gold; and the insolubility in this acid is absolute proof of their being gold.

An assay sufficiently accurate to decide on the value of an ore may be made as follows:

If the ore contains no other heavy metalliferous matters, it may be pulverized and washed in a bowl, throwing the water and light particles out, by agitation and rotary movement; when the gold will be found in the bottom of the vessel, since its high specific gravity retains it at the bottom of the water, while the other matters of a lighter nature, are washed out. If the ore is brown pyrites or a heavy ore, it will be necessary, after pulverizing it, to roast it thoroughly, raising the heat gradually to a full redness, and then taking the ore, pulverizing it again, and mixing in charcoal, to roast it a second time. After these operations, it may be washed, and the gold will be mostly obtained in the residual matter. It is, however, more difficult to remove the oxide of iron, and the remaining sulphuret, and it is generally requisite to digest the washed ore in nitric acid, perfectly free from any mixture of muriatic acid, which will take up most of the remaining matter, and leave the gold, the weight of which may be determined. I have sometimes operated on seven pounds of gold ore at a time, in this way.

Mercury may be used instead of nitric acid, in some cases, with advantage, and will take up the gold, which may then be obtained by washing out the rocky matters, and then distilling off the mercury, so as to leave the gold, which may be collected into a globule, by melting it on charcoal, with borax, by the aid of a blowpipe.

Owing to the very minute quantity of the precious metal obtained in these assays, the work is of extreme delicacy, and want of care will vitiate the result, so that no opinion of value as to the working quality of the ore will be arrived at, unless the operator is both careful and dexterous in his operations.

The only probable gangues of native gold in New Hampshire or Vermont, are the stria-

ted brown pyrites and the carious quartz, where similar pyrites has been decomposed. The brown pyrites is generally crystalized in right square prisms, with longitudinal striæ on one side and transverse ones on the other. It acts like ordinary iron pyrites, when heated before the blowpipe, giving the odor of burning sulphur, and leaving a crystaline magnetic bead of proto-sulphuret of iron, which breaks under the hammer. It is found in the talcose slate rocks of Claremont, and in numerous other places in the State.

Molybdenum.

This metal occurs in New Hampshire in two states, viz., the sulphuret and the oxide. The sulphuret resembles foliated graphite, or black lead, so closely that it is generally mistaken for it; but may be distinguished by the different colored mark it makes on a piece of China ware, the sulphuret of molybdenum giving an olive green streak, and the black lead, a black one. I heard of an instance of a mistake in the nature of this mineral which happened in the State—a person attempting to make black lead melting pots of sulphuret of molybdena, an experiment which utterly failed, his pots burning and falling to pieces in the fire during the process of baking them.

Sulphuret of molybdenum occurs in great abundance in the town of Westmoreland, on Lincoln's hill. It may prove of value for calico printing, since I found that the molybdic acid, formed from it, had the property of striking a fine robin's egg blue, by contact with metallic zinc. If a piece of cotton cloth is first saturated with molybdic acid, and then is struck with zinc blocks, or by rollers of zinc, with a pattern engraved in relief, a fine blue figure will be immediately produced on the cloth, and will remain while the molybdic acid may be washed out, leaving that portion of the cloth free from color. This being a new process not yet tried by any manufacturer, it is not easy to say what practical difficulties will arise in its application. A blue pigment may also be made from it by the action of zinc. Sulphuret of molybdena will make good writing pencils, but probably no better nor any cheaper than those of black lead, or graphite.

Chemists make use of molybdena in some experiments, but no other uses are known for it; though it is not improbable that many others, beyond those I have suggested, will ultimately be found out, since the mineral is in sufficient abundance to tempt experimenters to try it in various ways. Oxide of molybdena, or molybdena ochre, occurs in considerable abundance in the cavities of the vein of sulphuret on Lincoln's hill. It contains a minute proportion of oxide of uranium, amounting to six tenths per cent.

This mineral will make a very pretty pale yellow paint, a use to which it has not yet been applied, it being a rare mineral elsewhere.

Manganese.

This substance, which is the oxide of a very refractory metal, is found in various parts of the State, occasionally in the form of solid and compact black oxide, but more frequently as bog manganese, the nature of which has been discussed in a preceding section.

It will serve for umber paint, and for liberating chlorine from chlorhydric acid. Its localities have been described in detail in the topographical part of this report.

Analyses.

100 grains bog nodular manganese, from Jackson Emerson's, Gilmanton, consist of—

Water,	27.2
Vegetable matter,	14.4
Siliceous matter,	2.4
Peroxide of iron,	8.0
Oxide of manganese,	48.8
	100.8

Analysis of bog manganese, from Mr. James Bucklin's, Grafton. 100 grains yielded—

Water,	18.8
Vegetable matter,	5.6
Black oxide of manganese,	59.2
Silica,	12.0
Peroxide of iron,	6.4
	102.0

Silicate of manganese abounds in Winchester and Hinsdale, and any desirable quantity of it may be obtained. No other uses are known for it beyond those mentioned on page 127 of this report.

Analysis of silicate of manganese from Winchester. 100 grains contain—

Silica,	26.4
Peroxide of iron,	4.0
Red oxide of manganese,	68.0
	98.4
Loss,	1.6
	100.0

Cadmium.

This metal is one of the rarer class, and is only found in ores of zinc, particularly in the sulphuret or blende. It is procured for commercial use by saving the first product arising in the distillation of zinc, since it is more volatile than that metal. It resembles tin in its color, lustre and malleability, and were it sufficiently abundant, would prove a very useful metal in the arts. Its sulphuret is of a rich orpiment yellow color, and would make a beautiful and permanent paint. Even at its present price, it is worthy of the attention of artists.

Cadmium is rarely found constituting a larger proportion of blende, than three per cent. The zinc ore of Shelburne is the richest cadmium ore known in this country, and is equal to the richest in Europe.

I have separated three per cent. of it from that ore, and one per cent. of it from the blende of Eaton, and two per cent. from the Warren black blende.

Assay of Cadmiferous Blende.

The blende being attacked, as usual, by nitro-muriatic acid, and boiled until the metals and the sulphur are oxidated, the acid solution is diluted and sulphydric acid gas is passed through it, so long as a yellow precipitate falls. This is sulphuret of cadmium. When the precipitate has subsided, the clear supernatant solution is poured off, and the precipitate is collected on a filter, and washed; after which it is dissolved in nitric acid, which converts it into sulphate of the oxide of cadmium. This is decomposed by carbonate of soda or potash, and the carbonate of cadmium is collected on a filter, washed, dried and heated to redness, to expel the carbonic acid; and the oxide of cadmium is weighed. This is then reduced in a glass tube, by means of a little black flux, or still better, by dry hydrogen gas, heat being applied until the metal is reduced; a portion of it sublimes to the upper part of the tube, during the operation. Metallic cadmium looks, when on glass, like a silvery white mirror. It crystalizes in octahedra, and might be mistaken for rhombohedra of arsenic, by the eye, although it is readily distinguished from it by its forming a brown oxide, while arsenic is converted into white arsenious acid. Its sulphuret, as before observed, closely resembles sulphuret of arsenic or orpiment. Sulphate of cadmium is used in medicine, and by oculists in the treatment of diseases of the eyes. It is a white crystalized salt, resembling, in color and general appearance, sulphate of zinc, from which it differs in the forms of its crystals.

Chrome.

This metal has been found sparingly in New Hampshire, in the soil of Dublin, but not in any quantities of economical value. It has been discovered in loose masses in Vermont, and one specimen, given me for analysis by Mr. Paddock of St. Johnsbury, was a perfectly saturated chromide of iron, being devoid of magnetism, and having a coal black powder. Its original bed or vein is yet unknown, but it is supposed to have been found near Memphremagog lake, Vt.

Titanium.

The oxide of this metal is valuable in the arts of porcelain painting, and in the manufacture of mineral teeth, which are tinted of a delicate yellow color, resembling the natural organs, by adding a minute quantity of it to the felspar paste, of which the mineral teeth are made. It is found in considerable quantities in New Hampshire, in Merrimack, at Wilkins' mills, on the Souhegan stream; and in combination with oxide of iron, is an abundant mineral, on Mr. James Neal's farm, in Unity. Small quantities of it are scattered in various parts of the State, as mentioned in the preceding sections of this report.

It is valuable, selling, when pure, for nearly its weight of silver. In large quantities, it brings about $10 a pound; but the demand is quite limited in this country. It may become an article of importance to the porcelain painters of Europe, who often require a color like that produced by this mineral. About a dozen pounds of very fine oxide of titanium have been obtained in Merrimack, which has been sold in Boston for dentist's use.

If large quantities of chemically prepared oxide of titanium are wanted, Mr. Neal's mine will furnish any desirable quantity, since it there occurs in a regular vein of considerable magnitude. (See description of that locality.)

Arsenic.

Arsenic is a brittle, volatile metal of a white color, resembling in lustre polished steel. Its crystaline form is an obtuse rhombohedron of 114° 26′, and its sp. gr. is 5.627. It becomes tarnished by exposure to the atmosphere, and is then of a grey color. It volatilizes without fusion, and, in close vessels, re-crystalizes in cooling. This may be effected conveniently in a glass tube, and the crust of arsenic appears on its surface like a resplendent mirror, while the inner part of the crust is observed to be crystalized, presenting brilliant triangular facets, which are the planes of rhombohedrons.

Metallic arsenic may be obtained by mixing white oxide of arsenic with black flux, or charcoal, and heating it to dull redness, while a cold crucible is inverted over it, and receives the condensed metal.

It may also be readily obtained by subliming it from the arsenic ores of Jackson, Dunbarton, Epsom and Haverhill, the ore being placed in a crucible as above described; or it may be sublimed, still more conveniently, in an earthen retort, and may be obtained by breaking off its neck and striking it with a hammer, so as to detach the crystaline metal, which will come off in the form of a conical tube, lined with crystals. Metallic arsenic is used in making speculum metal, and for alloying lead in the manufacture of shot, it being necessary, to make the shot granulate perfectly, as the lead is poured out through the seives. The substance known in commerce under the erroneous names of *cobalt* and *fly powder*, is metallic arsenic, mixed with a portion of arsenious acid. It is a dangerous poison, but not so virulent as arsenious acids or white arsenic. Arsenious acid is the poison known as ratsbane, or white arsenic, and is an extremely poisonous substance. It is used in the manufacture of various paints, among the most beautiful of which are Scheele's green, or arseniate of copper, and realgar and orpiment, which are sulphurets of arsenic, the latter being known under the name of King's yellow.

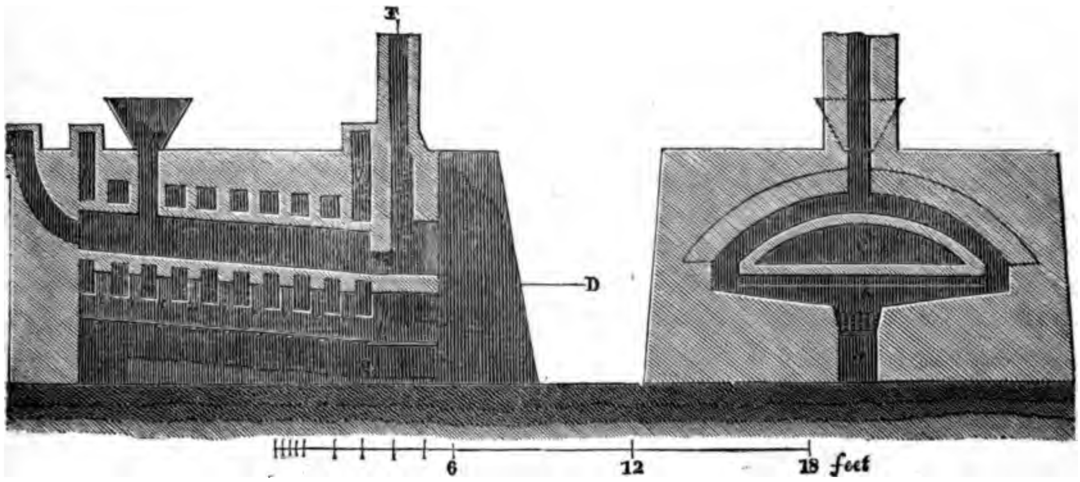
The ores of this metal are by no means rare in New Hampshire, several large veins having been discovered in Jackson and Dunbarton, and smaller ones in numerous other places. Its common ore is the arsenical pyrites, or arsenical iron, which consists chiefly of arsenic and iron, combined in their metallic state with sulphur.

Arsenic also occurs native, or in nearly a pure state, but it is more frequently combined with iron. In Haverhill it is found near Mr. Wilmot's, in its native or metallic state; in Jackson, Epsom and Dunbarton, in the state of arsenical pyrites, very rich in arsenic, and capable of being wrought advantageously for the metal. When heated to redness in close vessels, the metallic arsenic is sublimed and crystalizes in splendid rhombohedral crystals, in the cold part of the apparatus. The Jackson ore gives but very little sulphuret of arsenic or realgar, which forms beautiful octahedral crystals, of a rich orange red color, in the coolest part of the retort neck, it being more volatile than the metallic arsenic. The ore yields about 40 per cent. of the metal by distillation, but a considerable proportion of the metal still remains behind, combined with the iron. It may be manufactured

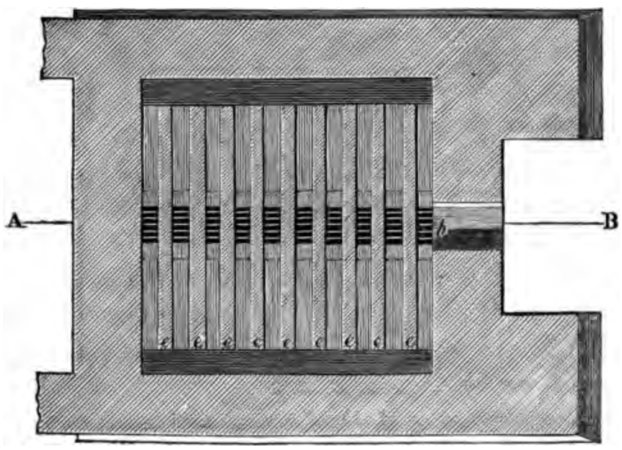
30

on a large scale in furnaces like the one represented below, which is from a plan contained in Dumas' *Chimie applique aux Arts. Atlas, pl.* 44, *Fig's* 1, 2, 3.

Section through A. B. Section through E. F.



Section through the plane C. D.



Furnace for subliming and oxidating arsenic.

a, ash pit; *b*, fireplace, or grate; *e e e*, little arches of brick which support the muffle; *c*, muffle of fine clay for the ore; *f*, hopper or trough through which the ore is introduced; *d*, passage for the arsenious acid into the condensing chamber; *h h*, smoke pipe conducting the smoke to the chimney; *g*, draught to take off the arsenical fumes which escape from the muffle, to prevent its affecting the health of the workmen.

Cobalt.

Cobalt is a greyish white metal, resembling in color platina, and was discovered in Brandt, in 1733. It is not so malleable as iron, and is very difficult to obtain in pure and solid masses. It possesses magnetic properties like iron, but in a less degree.

It combines with oxygen in three proportions, and the two first oxides combine, forming a fourth state of the oxides, known as cobaltic acid. Oxides of cobalt are reduced to metal, at a white heat, with carbon or hydrogen gas.

No use has been made of the metal, but its oxides are highly valued for giving the deep blue color to earthern ware, porcelain and glass; also for making smelt, which is used as a pigment. Thenard's blue is a combination of precipitated alumina and oxide of cobalt, combined by exposing the mixed precipitates to heat.

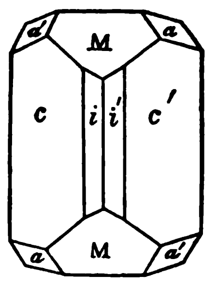
Cobalt is found, in nature, combined with arsenic, sulphur, nickel and iron.

In New Hampshire, it is found in the arsenical sulphuret of iron of Franconia, constituting a small proportion of the mineral. It was analyzed by Mr. A. A. Hayes, some years since, and received the name of Danaite, in honor of the late Prof. Dana of Dartmouth College. Mr. J. D. Dana regards it as a variety of mispickel, considering the cobalt as an accidental and variable constituent. (See J. D. Dana's Mineralogy, p. 475–6.)

According to Hayes, this mineral consists of—

Iron, - - - -	32.94
Arsenic, - - - - -	41.44
Sulphur, - - - -	17.88
Cobalt, - - - - -	6.45
	98.67

For the following drawing and measurements of one of the crystals of this mineral, from Horace Brooke's farm in Franconia, I am indebted to Mr. J. E. Teschemacher, who made the measurements from a crystal furnished by me.



Primary form, the right rhombic prism.

M on M 68 do, over summit 112. *a* on *a'* 121.30. *c* on *c'* 100.15. Planes *i i'* too dull to measure.

Planes P P are obliterated by modification *c*, on the acute angle of the right rhombic prism.

Brongniart observes that cobalt, as well as silver, is frequently found in small quantities in arsenical pyrites.

Although this mineral is sufficiently rich in cobalt to work for that metal, still the ore being scattered in separate crystals, the locality will not furnish an adequate supply for a furnace. It is an interesting mineral, and will always attract mineralogical travelers to the spot. Hence it may be regarded as valuable to the State. It is not improbable that

the arsenical ores will be found to contain cobalt, but we have not yet had time to analize the residual matter, left after subliming the arsenic from them.

Tungsten.

This metal was discovered by Scheele, in 1781. It is obtained by chemical means, from its ores, and is, when pure, a greyish white metal, which is brittle and fused with difficulty. Its specific gravity is 17.5. It forms two combinations with oxygen, one of which is brown, and the other yellow. The latter is called tungstic acid. (*Phillips' Min'y.*)

Tungstic acid occurs in nature, combined with lime, forming tungstate of lime or scheelin, and in combination with oxides of iron and manganese, constituting the mineral known as wolfram, which is one of the most frequent minerals found with tin ores. It occurs in Saxony, Bohemia and Cornwall, in large crystals. In Jackson, it is found in fine grains, in the mica slate, which contains the tin ores on Eastman's hill.

Tungstic acid is employed in porcelain painting, and in giving a delicate yellow tint to mineral teeth, answering in the place of oxide of titanium. It is a rare mineral in the United States, but is found in considerable abundance in the Saxony and in the Cornwall tin mines.

Uranium.

Uranium was discovered by Klaproth, in 1789. It is a rare metal, found in the pitch blende, uranite and chacolite, (*See books on Mineralogy.*) In New Hampshire, it occurs sparingly in the molybdena ochre of Westmoreland, and gives the remarkable rich yellow hue to that mineral. Oxide of uranium is a valuable substance for painting on porcelain, and is used to some extent for that purpose. Pitch blende contains the largest proportion of this oxide, and is the ore from which it is extracted by chemists. It frequently accompanies gold and silver ores in Saxony, Bohemia and Hungary. It is occasionally found with tin ores.

It will be seen by this list that New Hampshire is unusually rich in minerals, a greater number of the metals having been found within her borders than have yet been discovered in any other State. Some of the usual metals may be economically extracted, and in the course of time, we shall see furnaces erected for the purpose.

The ores of iron, zinc, copper, lead and silver are those which are deemed of the most importance. The others may be regarded as interesting minerals, calculated to advance the cause of science, and will not fail to attract many mineralogical travelers to the State; so that the chances of new discoveries will be very much increased. It is not at all probable that I have discovered all the localities of important minerals; for many places not yet seen, may be exposed to the scrutiny of men of science, from whose observations much additional light may be obtained.

When excavations are made by mining, new minerals, often of interest and beauty, are thrown out, when only poor specimens were found at the surface. Few mines have yet been properly wrought in the United States, and we as yet have but little practical knowledge of our mineral resources.

The geologist and mineralogist point out the most favorable spots for research, but the miner must follow with his deep pits, before we can discover the extent and value of many veins. Some ores may be distinctly traced in the outcropping veins and beds, and enough may be discovered to satisfy the miner that the place is worth exploration, and the capitalist that he may safely invest his money in the enterprise; but still there are many localities where there is much uncertainty, and a risk must be encountered in the undertaking. Those who may read the history of the Cornwall mines, will find that many adventurers have met with severe losses, and will learn that, even in that rich mineraliferous region, mines do not on an average, pay more than six per cent. on the capital invested, while there are some that are very productive. It is this chance of finding a productive mine, that stimulates the researches of adventurers in mining, and they stand a better chance of success by following the advice of disinterested geologists and engineers of mines, without heeding the opinions of mere laboring miners and speculators, who may be seeking for employment, or to manufacture fancy stocks, to the great injury of the real mining interests of the country.

When there is reason to believe that any new branch of industry is about to be established in the State, whereby the raw materials, which in their natural state are worthless, may be rendered valuable, every lawful facility should be granted by the government in aid of the enterprise, while idle speculators should be discouraged, as having a prejudicial influence by destroying public confidence.

Whoever engages in mining, should carefully count the cost, and consider well the nature of the business and his own qualifications for conducting it. The want of this circumspection has brought ruin on thousands of enterprising men, who unfortunately regarded the working of a mine as the certain means of acquiring wealth.

AGRICULTURAL GEOLOGY AND CHEMISTRY.

So varied and extensive are the applications of geological and chemical science to the art of Agriculture, that only a brief summary of some of the elementary principles, and an account of a few of their more obvious applications, can be comprised within the limits appropriated for this section of the report.

We may divide the subject into—

I. An account of the origin of the mineral ingredients of soils and of their distribution:

II. The nature and origin of the organic matters of soils, and of the saline ingredients accompanying them:

III. The nature of the substances, both mineral and organic, which are found in plants, and their origin:

IV. What ingredients are taken from soils by the crops, that are grown upon, and removed from them:

V. The best methods of restoring fertility to exhausted soils, or to improve those which are unfertile.

I. *Origin and distribution of soils.*

The mineral ingredients of all soils were derived from the disintegration and decomposition of pre-existing rocks, and are constantly forming from the gradual decay of those, which are now exposed to the influence of their usual causes of decomposition.

The nature of the rock determines that of the soil, and there are as many kinds of soil as there are of rocks, from which they were derived. In general, the primary aggregates, or crystaline rocks, have a common character, consisting of the disintegrated and partially decomposed minerals of those rocks; but how variable are those aggregates in the relative proportions of their ingredients, and, consequently, how much the soils must vary in their texture and chemical constitution! It is, therefore, a great error to generalize too precipitately on this subject; for even within the limits of a single kind of rock there may be, and are, variations, which notably affect the character of the soils derived from them. When we observe the soil originating from mica slate, it is impossible for any one, at all familiar with the subject, not to perceive that it differs altogether from a granitic soil, being far less siliceous, more charged with alkaline ingredients, and being warmer and more retentive.

In crossing the State of New Hampshire, from the Connecticut river to Portsmouth, near the southern part of the State, the traveler will pass over soils formed from the detritus of granite, gneiss and mica slate, and cannot fail to notice their difference in fertility, the mica slate soil being by far superior to the others.

Having a good specimen of a very fine decomposed micaceous soil, obtained from the farm of Mr. Levi Bartlett of Warner, I have analyzed it, and here state its composition in illustration of the foregoing remarks.

It is of a greyish white color, light, porous, and contains minute scales of the undecomposed mineral. It is used by Mr. Bartlett, with great propriety, for fertilizing reclaimed peat bogs, and in making compost manures.

100 grains of the soil yields, on analysis—

Water, - - - -	3.6
Decomposed vegetable matters, - -	1.8
Silica, - - - -	79.2
Peroxide of iron and alumina, - -	5.6
Potash, - - - -	2.2
Soda, - - - - -	2.5
Lime, - - - -	3.2
Magnesia, - - - - -	1.2
	99.3
Loss, - - - - -	.1
	100.0

This soil has not been fully exposed to the action of vegetation, or it would have been less rich in alkaline and calcareous matters.

The felspar and mica of granite and gneiss vary in their relative proportions, and also their facility of decomposition ; hence the soils must vary accordingly.

Pure quartz is utterly insoluble, and is not taken up by plants, and has no action beyond that of a mechanical nature.

An exhausted granitic soil presents an excess of grains of quartz, the felspar and mica having been removed by decomposition. The sandy plains, called pine barrens, consist mostly of small rounded grains of quartz, which is the indestructible ingredient of granite from which it was derived.

The following is an analysis of a *granite subsoil* from Mr. Fiske's land, Dublin. It contains fragments of undecomposed granite, and is in the midst of rocks of the same kind, while the rocks to the north of it are also granite—

Water, - - - -	1.8
Decomposed vegetable matters, - -	5.4
Silex, - - - -	84.4
Alumina and peroxide of iron, - -	6.8
Lime, - - - - -	0.3
Magnesia, - - - - -	0.8
Traces of alkalies and loss, - -	0.5
	100.0

Numerous other examples will be found among the analyses, which will follow this article. It may be stated that mica slate soils are more fertile than those of granitic origin.

A still more marked difference is observed between hornblende rock and granite soils, the former greatly surpassing the latter in fertility. (See Report on the Geological and Agricultural Survey of Rhode Island.)

Sienite rock contains more felspar than granite, and, therefore, forms a better soil. Its hornblende is also a valuable adjunct, furnishing magnesia.

Porphyry rocks are slow in undergoing disintegration, but, consisting wholly of felspar, and containing both potash and soda, form an excellent soil. It is rarely abundant or deep.

Trap rocks are more readily decomposed, and form the warmest and most fertile soils, containing the alkalies, lime and magnesia in sufficient proportions, and yielding them slowly to vegetation. This rock is remarkable for its peculiar soil, the limits of which are generally marked by certain plants, which luxuriate upon it, and often indicate by their presence the proximity of the rock, even when it is concealed from view.

Argillaceous slate rocks give origin to a tough blue, or brownish colored soil, often filled with fragments of the slate. It is a cold and heavy soil, but is capable of being improved by underdraining and admixture of sand, by which it is rendered fertile. It is retentive of water and manures, since it admits of no infiltration, and does not allow the air sufficient access to effect the decomposition of organic bodies. Clayey soils, therefore, generally retain their alkaline and calcareous ingredients, while they are speedily washed out from a soil of more open texture, like that from granite. The small cereal grains flourish admirably on a clayey soil, which contains from 2 to 5 per cent. of lime. Even a smaller proportion of that ingredient serves to render the clay tolerably fertile. Unless underdrained, it is apt to retain stagnant water, which injures the crop.

Limestone soils differ still more remarkably from the preceding, and vary in their composition, according to the nature of the rook from which they originated, and their exposure to the action of water and vegetation, which remove the calcareous ingredient and leave its siliceous matter, so that the surface soil is frequently devoid of carbonate of lime, only the silicates and alumina remaining. Sometimes the surface is covered with drifted soil, derived from a more northern locality, which has led some writers into erroneous theories respecting the character of soils from limestones. In some instances, the drifted detritus from the limestone rocks is found to the southward of the ledge from whence it was derived, as in the northern parts of Maine and New Hampshire, where soil from the Canada silurian limestones is found on primary rocks.

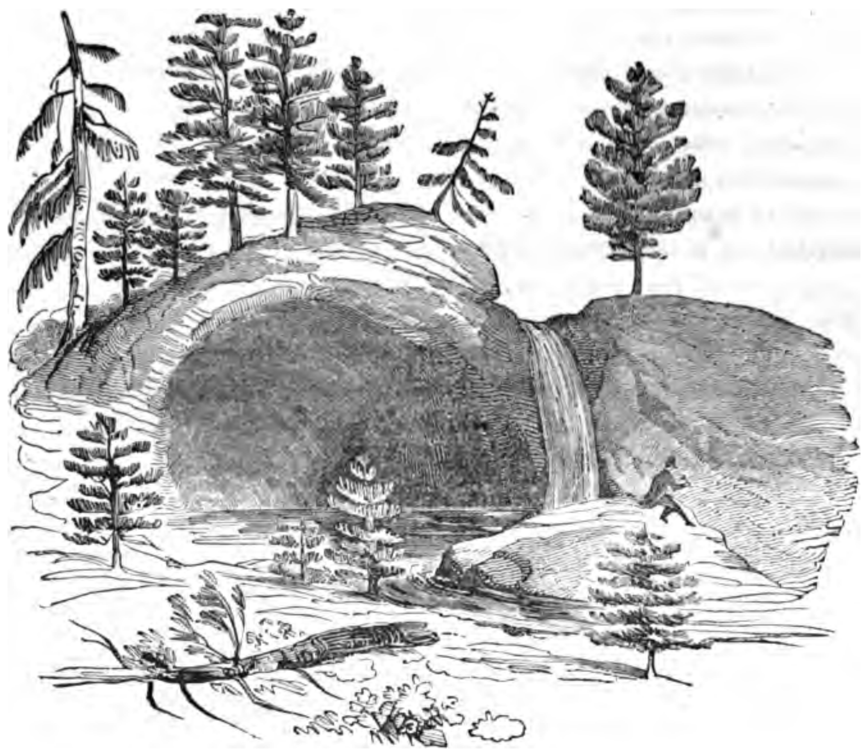
On the other hand, in Maine, the soil on the limestone of Thomaston was derived from the mica slate hills to the northward. Hundreds of similar cases might be cited, if necessary, but the above are amply sufficient to explain the principle. The character of a soil is not to be decided by the nature of the rocks on which it rests, but by that of the small stones it contains, and the partially decomposed minerals which constitute the soil, and by a survey of the region from whence the drifted materials were derived. This has been fully explained in the Geological reports of Maine, Rhode Island and Massachusetts.

Distribution of soils. Drift and Alluvion.

Soils were distributed by the action of water in ancient times, and by more limited currents during recent epochs.

The ancient overflow of waters from the north is regarded by the geologist as a wise and merciful dispensation of Providence, manifested anterior to the creation of man, and destined to remove and duly commingle the soils from various rocks, so as to render the earth more uniformly fertile, by a mixture of various ingredients, which is known to produce favorable results.

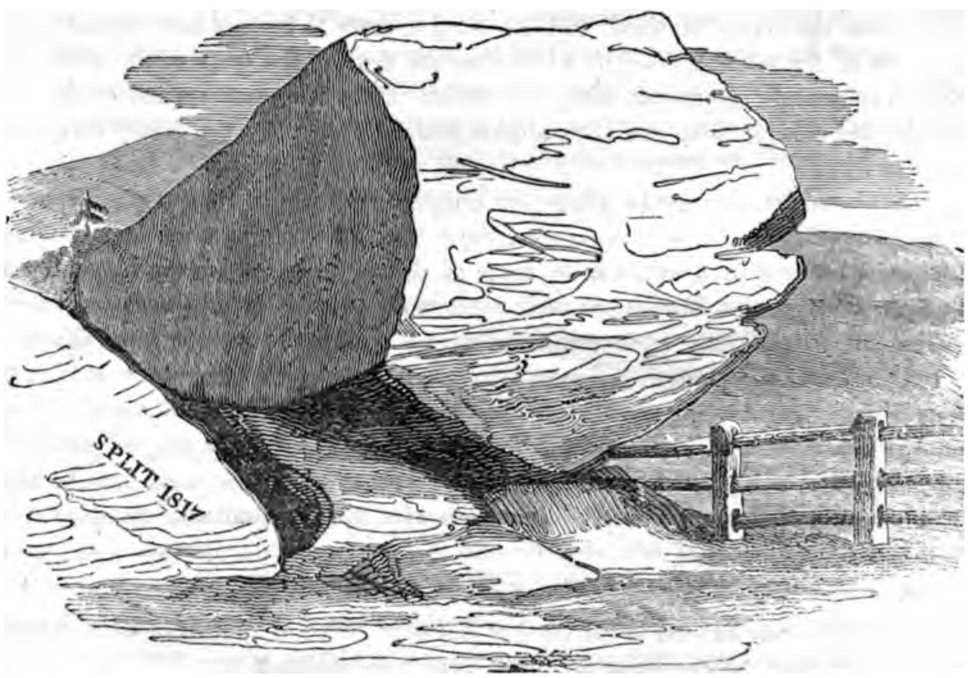
The power of falling water, aided by stones, sand and gravel, acts continually on the rocks beneath a fall, and deep, bowl-shaped cavities are worn out in the hardest granite rocks. The basin of the Pemmesawasset is a beautiful illustration of this long continued abrasion: a deep basin, of an oval form, 20 feet by 30 feet, having been excavated, and being constantly filled with clear, cold and transparent water, is an object of curiosity, visited by travelers to the White Mountains. The sketch below will give an idea of its appearance.



Basin of Granite at the falls of the Pemmesawasset brook, in the pass of the White Mountains.

Freshets bring from the mountain sides the finely divided detritus, resulting from the decomposition of rocks, and great overflowing rivers spread this alluvion widely over the inundated meadows, and, losing their velocity, as the stream widens into a broad lake, the fine particles are deposited, so that a new soil is laid down, from which springs up a more luxuriant crop of vegetation. Every year, this operation of nature is repeated, and the intervales are top-dressed with fertilizing substances. Every streamlet and river, however small, performs a similar work in proportion to its capacity, and the hill sides come swimming down to renew the exhausted soil. Vegetable matters, in combination

with the earthy bases, are also conveyed to the meadows by similar means, and the excess passes off into the sea, and there serves to form the fine rich ooze, or mud, in which the marine plants flourish and shell fish live. In the course of time, a shoal, and then a little island, and at last a broad delta appears at the river's mouth, and a rank vegetation soon finds a foothold and covers the new land with verdure. Thousands of rivers are at this moment depositing new land in the sea, and millions of tons of finely comminuted rocks are transported annually from the mountains and plains, to contribute towards the completion of the work. The shell fish secrete carbonate of lime from the sea water, and add their shells to the accumulating mass, which the plough of the future husbandman will till, though he may not, perhaps, unless more advanced in science than some of the present generation, suspect that the ocean's waves once rolled over the spot he may then be cultivating. Silently and slowly this new deposit is forming, and those who seek for identity of action in times past and present, may contend that by the same kind and degree of drifting, the ancient soils and rocks were removed to the southward. The magnitude of the operation, and the great size of some of the drifted materials, forbid our adopting any such views; and we are led to believe that a current of gigantic power was sent, by some sudden movement, over the half sunken continents of the northern hemisphere, carrying with it large sheets and mountains of ice from the arctic regions, and sweeping along loose rocks which lay on the mountains, which then were islands, while the current itself swept along the soil in its impetuous course.



Sketch of the Vessel Rock in Gilsum. (See, also, page 88.)

Such appears to be the most plausible theory of drift phenomena, and the theory is supported by many weighty arguments, which, although perhaps not so solid as the granite

blocks themselves, are worthy of attentive consideration. In every part of New Hampshire, Vermont, Maine, Rhode Island and Massachusetts, the scratched rocks and transported materials indicate the northern origin of the drift; and in Maine, the scratches point most frequently N. 15° W., while in New Hampshire, they point more northwardly, and in the western part of the State, and in Vermont, a little to the eastward of north, indicating by their convergence, a central point, from whence the current entered New England. Similar phenomena have recently been observed in Lapland, Norway, Sweden and Russia, where the action is as marked as in this country.

The importance attached to this subject, viewed agriculturally, is not to be overlooked, for we shall know better the laws of distribution of ancient or diluvial soils, by tracing the materials back to their original beds, and at the same time a clue may be obtained to the origin of rolled masses of valuable minerals, which may be turned up by the plough, when we know the theory of drifted rocks.

Dust or soil transported by atmospheric currents.

Less important is the transporting power of atmospheric currents, although not to be overlooked; since the accumulation of dust in buried cities, evinces the power of long continued depositions of fine particles, wafted by the wind. Sand *dunes* are examples of mineral matter drifted by the wind, which carries forward the particles in the same manner that dry snow is moved by the same cause; and the encroachments of drifting sand have, in some countries, laid in barren waste the richest fields. The great deserts are often in motion from the action of wind, and the sand appears to have almost as much freedom as the waves of the sea. Soils drift when they are dry, by the force of the wind, but little effect is commonly produced, since vegetation protects a large portion of the surface, and the dry soil drifting from one spot, alights, and is retained by the grassy turf which it meets in its way.

The above remarks may not be altogether uninteresting in the history of soils, and they are given with that view. We can control the action of water in some measure, and by irrigation may imitate, on a small scale, some of the more gigantic operations of nature. By sowing coarse grasses, turnips, or savin trees, and other suitable plants, we may also give permanency to drifting sands, which are urged upon our fields by atmospheric currents; but the latter applications are more likely to be required on the sea coast than in the interior. Some inland soils may also be protected in this way, as in cases where the fine sand of a pine barren is blown upon a neighboring field. This may be prevented by sowing plants that will grow in sandy soil; or by adding ashes, the sand may be made to bear English grasses, and may be profitably reclaimed from barrenness.

Origin of the organic matters of Soils.

Mineral bodies alone existed in the earliest stages of creation, and from them sprang the elements constituting the corporeal matter of plants and animals.

The action of a First Cause, is regarded alike essential to the origin of minerals, plants and animals. Admitting this, we have only to inquire how the first created plants and

animals subsisted on the face of the new born planet. The creation of the one is as miraculous to our understandings as the other; but after they became existent, it is supposed that they were subject to the same laws as now prevail. Secondary causes, then, are the only ones we are authorized to investigate by scientific means.

The first plants, as proved by geology, were those which are analogous to plants that are known to live upon mineral elements exclusively, or upon the elements of air, water and certain mineral salts; viz., the cryptogamous vascular, agamous and monocotyledonous plants; while in subsequent periods, a more complicated organization was introduced. (See p. 19—20.) Those classes of plants may have laid the foundation of organic matter, on which the higher orders grew; for they would consolidate a sufficiency of carbon from the carbonic acid of the air, to furnish the mould for the sustenance of others, requiring it for their growth. That they did this and much more, is obvious from the enormous accumulation of coal, resulting from the carbonaceous matter of the early vegetation of the globe.

Plants of the higher orders, when grown in pulverized quartz, with saline matters, do not produce seed, but the foliage grows very well. When the plant dies and decays, a mould or humus is formed, and the next crop does fructify. This abortive attempt was avoided by *Nature*, and plants, independent of mould, were first grown on the earth, as above mentioned; so that the first plants of the higher orders were enabled to propagate themselves by seed, as they do now.

The earliest mould formed from the first plants, was probably composed of the same ingredients as it is now; for coal contains the same elements as peat, excepting the absolute want of the alkalies, which may have been washed out into the fine clay beneath it, that substance containing the alkalies. Ammonia, indicating the presence of nitrogen, arises from the combustion of coals, as from recent wood. Carbon, hydrogen, nitrogen and oxygen are its components, with a variable proportion of earthy and saline matters.

Origin of Peat and Swamp Muck.

Peat arises from the disorganization and partial decomposition of vegetable matters in water, and the changes that take place, are very different from those which arise from exposure of the dead plants to the atmospheric influences, and to the basic or earthy and alkaline ingredients of soils.

Peat is mostly formed by the growth of sphagnous mosses, the roots and submerged stems of which die and decompose, while the plants grow from their upper parts, and furnish a continual supply of carbonaceous matter, consolidating, by their functions, a portion of the carbon contained in the carbonic acid gas of the atmosphere. On cutting out a mass of peat, every observing man must have observed the gradual manner in which the living stems and roots of the peat mosses pass into soft, disorganized peat mud, the principal mass of which is made up from the remains of the mosses.

Dead leaves, rotten trunks and branches of trees also enter into the composition of a peat bog; but they form only a small proportion of the bog, though they generally attract more attention, on account of the perfect preservation of their forms, by which the nature

of the tree may be recognized, even when its substance is perfectly brown, black and rotten.

Peat formed from mosses, possesses antiseptic properties, so that wood and even animal substances remain in it undecayed for a long time, animal bodies being not unfrequently found converted into a kind of hard fatty substance, called adipocire. This takes place only when the peat is completely saturated with water, so as to prevent the access of atmospheric air.

The products of vegetable decomposition under water, differ essentially from those arising from exposure to the air, as before observed, and the changes which take place in a bog by draining and ploughing it, are more complicated than many imagine.

It contains, according to my analysis, crenic acid, mostly combined with lime, magnesia alumina and oxide of iron; apocrenic acid; humic acid; humin and ulmin, the latter being found in brown peat; extract of humus, consisting of two distinct substances; vegetable fibre, disorganized in part; phosphoric acid, combined with the earthy bases; sulphuric acid, combined with alumina and with oxide of iron; oxide of manganese; also a little potash and soda, sea salt and silica.

There are, probably, other organic acids in some kinds of peat, but the above mentioned are those which are generally present.

When peat is exposed to the air, it blackens, and evidently undergoes a change in its composition, a large proportion of apocrenic acid being produced by the action of the atmosphere; a change analogous to that which takes place when yellow subsoil is exposed to the action of the air, and becomes black mould.

According to Mulder, when air is admitted, the ulmic acid and ulmin of peat are converted into humic acid and humin; but since, in his analysis, the crenates and apocrenates were not removed, but only the free acids, his experiments should be repeated with that precaution, before his views are adopted.

By Mulder's analysis, ulmin of peat is composed, in atomic proportions, of carbon 40, hydrogen 36, oxygen 16.

Its ammonia salt is composed of—

		Atoms.
Carbon,	61.43	=40
Hydrogen,	4.92	=40
Nitrogen,	3.04	= 2
Oxygen,	30.61	=15

Peat from Harlem lake, dissolved in a solution of carbonate of soda, and the humin being precipitated by chlorhydric acid and dried at 140° centigrade, was found to consist of—

		Atoms.
Carbon,	60.13	=40
Hydrogen,	4.74	=38
Nitrogen,	3.61	= 2
Oxygen,	31.55	=16

It is evident, in this analysis, that the nitrogen was derived from the apocrenic and crenic acids in the apocrenates, which were decomposed by the carbonate of soda, and were mixed with the humin obtained by the process.

Berzelius gives the following analysis of vegetable matter decomposed under water, which sustains the views I published in my Report on the Geological and Agricultural Survey of Rhode Island, and those above expressed:

Fibrous vegetable matter, - -	4.32
Crenic acid combined with lime and moisture separable by heat, - -	1.33
Crenic acid and apocrenic acid, likewise humic acid, magnesia, alumina, oxide of iron and manganese, - - -	6.02
Humin, - - - -	2.01
Carbonate of lime and muriatic acid, -	1.23
Fine sand, from granite, - -	2.12
Water, - - - -	82.06
	99.09

(*Lehrbuch Der Chemie, von I. I. Berzelius,* 8r. *Band, p.* 427, 1839.)

Peat always contains nitrogen, and will give out ammonia by the action of hydrate of potash, when treated by Will and Varrentrapp's method. This is owing to the presence of the highly nitrogenized apocrenic and the crenic acids, which are present in all the peats I have analyzed.

This principle is one of considerable practical importance; since, as I shall demonstrate, these acids play an important part as fertilizing agents, and are readily convertible into other substances which enter into the composition of plants.

Peat also contains a small proportion of phosphate of lime, a saline ingredient which enters into the composition of cereal grains in large proportions, and is one of the constant ingredients of all plants that have been analyzed. Phosphate of magnesia is also present in several kinds of swamp muck and peat, and is also an important salt required by all plants.

It is well known that when recent peat is spread freely on soil, it generally acts unfavorably on vegetation, and the farmer justly says it is sour and worthless in that state. This acidity will be recognized by those who have seen the stones thrown out from bogs; for all those matters which acid would attack and dissolve, are found to have been removed, every trace of felspar and mica are found to be dissolved from a piece of granite, and a white siliceous skeleton of the stone remains. All the oxide of iron is generally taken up also, unless, as is sometimes the case, the bog is already saturated with it.

Sulphate of iron and sulphate of alumina, not unfrequently, are also present in excess, and exert a baneful action on plants.

These facts will serve to explain why peat should be operated upon by certain ingredients having alkaline or basic properties, so that the acids may be saturated, and the noxious salts decomposed before the peat can be advantageously used for manure.

I have always earnestly protested against the employment of acid peat on soils, and have advised farmers to convert it into a neutral compost by means of animal manures, capable of generating ammonia, and lime or ashes, the two last being mixed into the compost after it has fermented sufficiently to give out ammoniacal gas by the action of alkaline matters. Lime and potash will disengage a portion of ammonia from some kinds of peat, and will saturate the noxious acids, converting them into fertilizing salts by combining with them. Hence lime is generally a valuable top dressing for reclaimed peat bogs, and will render them fertile.

Earthy substances, which will combine with acids, serve on bogs by combining with the acids of peat. Hence a fine loam from decomposed mica slate, or from granite, is an excellent fertilizer; for the alkalies, the alumina, magnesia, oxides of iron and manganese, act as electro-positive bodies, and combine with the acids, or electro-negative ingredients in peat, and form neutral combinations of various degrees of solubility. Sand, consisting of grains of quartz, is inert, and it is a waste of labor to spread it on a bog, when any subsoils, containing the other minerals, can be had; and by attending to the nature of soils the farmer may act with a more just discrimination, and thereby make more thorough improvements at less cost.

Solubility of Peat in Alkalies.

The solubility of peat in alkaline solutions was known as long ago as 1779, and was applied to agricultural use. It was fully described by the Earl of Dundonald, and was warmly recommended to the agricultural community, as a good method of obtaining the concentrated juices of peat for transportation from England to the sugar plantations of Jamaica.

Dundonald says that it is like the juice of dunghills. The following is an extract from his work:

Action of Alkaline Salts on Peat. Extract from Dundonald.

"Oxygenated vegetable matter and oxygenated peat, when decomposed and rendered soluble by alkaline salts, assume a brownish red color, and are tasteless; hence the alkali must enter into combination, and be neutralized by an acid, or acids." P. 49.

"By exsiccation the above mentioned extract, (which is very similar in its color and effects on ground to the juice of the dunghills,) assumes the appearance of a darkish brown gum, soluble at any time by the application of water. Alkaline substances act in the same manner on oxygenated fossil coal, as they do on oxygenated vegetable matters or peat, forming, likewise, a brownish red liquor, which equally promotes vegetation. The acids contained in oxygenated fossil coal, in a state of combination with calcareous matter, will probably be found to be the phosphoric acid, the acid of borax, and that of sorel, or the oxalic acid." P. 50.

"As dung is said to be sent from Britain to the West Indies, this circumstance, (together with the chemical remarks and observations on the nature of peat,) has pointed out peat as an article capable of being sent in certain states of preparation to the West India

Islands, with a view to supply the annual consumption and deficiency of vegetable matter, which may take place in the soil by the cultivation of the sugar cane." P. 202.

"There can be no doubt that when peat is rendered completely soluble, and thus fitted to promote the growth of plants, it will, when applied to the culture of the sugar cane, afford those substances which constitute sugar; when these, by the process of vegetation, are afterwards combined and united in due proportions." P. 203.

"To send cargoes of peat in an unprepared state to the West Indies, would be the height of folly and absurdity, as no vessel could carry enough of so light a substance even to ballast her. But as peat, when dissolved by alkaline salts, and afterwards dried, may be brought to the consistency of a solid, dry gum, equal in weight, perhaps, to forty or fifty lbs. per cubic foot, the objection to its lightness would thus be remedied, and it might be exported to the West Indies at a low return freight, or as ballast." P. 203.

"The improvement here suggested by the application of peat as a manure to sugar plantations, is perfectly new, and as such, with a certain set of men, (whose opinions are not worthy of attention,) the proposal may be subjected to the epithet of a scheme, an appellation now generally bestowed on all designs, whether the discovery be valuable or useless." P. 204.

Dundonald's Agriculture.

During the past year I obtained, through the kindness of a friend, the loan of a rare old book on the Chemistry of Agriculture, which contains so much valuable information that is supposed by many to be of recent origin, that I have thought it worthy of especial notice. I have, therefore, given extracts from the most important sections relating to our subjects.

This work was written and published soon after the discovery of the composition of air by Priestley and of water by Cavendish, and those gentlemen assisted its author in the preparation of the work. It is a better treatise than has been published since its day, and was laid before the public before the agricultural community were capable of appreciating its merits.

It is entitled, "A Treatise showing the intimate connection that subsists between Agriculture and Chemistry, addressed to the cultivators of the soil, and to the proprietors of fens and mosses in Great Britain and Ireland, and to the proprietors of West India estates, by the Earl of Dundonald, London, 1795."

This book has been strangely overlooked by modern writers, who might have profited by its perusal. Lord Meadowbank has also published an excellent work on the management of peat bogs, but I have not seen it.

Extracts from Dundonald's Treatise on Agriculture and Chemistry. Oxygenation.

"The insolubility, to a certain degree, of this system, adopted by nature, is undoubtedly to be preferred to one more completely soluble; for it is evident, that if putrefaction, or oxygenation, had possessed the power of rendering all the vegetable matter, by a speedy process, soluble in water, two pernicious consequences must have followed: the rains

would have washed down such extracts and soluble matters, as fast as formed, into the rivers and springs, contaminating the waters, and rendering them unfit for the existence of fishes, or for the use of terrestrial animals. The sea, in process of time, would thereby receive all the vegetable and animal produce of the dry land, and the earth would ultimately become barren, consisting alone of the simple earths, without any admixture of vegetable matter; consequently there could be no accumulation of this substance on the surface, as is the case, to an immense degree, at present. As such, there cannot be a doubt, but that the present incomplete process of putrefaction, oxygenation, or solution of organic bodies, has been established by the Great Creator of all things for wise and benevolent purposes; especially when it shall be understood, that the apparent imperfections to this, (to a certain degree,) insoluble system are, as they respect agriculture and vegetation, to be remedied, when necessary, by the ingenuity and industry of man." P. 30.

To make a compost with peat, Dundonald remarks:

"This object is best attained by mixing newly made and completely slacked lime with about five or six times its weight of peat, which should be moderately humid, and not in too dry a state. In this case, the heat generated will be moderate, and never sufficient to convert the peat into carbonaceous matter, or to throw off, in the state of fixable air, the acid therein contained. The success of most operations, but more especially those of a chemical nature, greatly depends upon a regular and due observance of circumstances apparently trivial. This preparation of lime and peat is in a peculiar manner conducive to the growth of clover, and of the short, and, as they are called, sweet kinds of pasture grasses. The soil, also, by the application of it, acquires such a predisposing tendency to promote the growth of such grasses as to prevent its growing afterward rank, coarse, or sour herbage. Notwithstanding that this preparation of lime and peat is certainly, when properly made, a valuable manure, yet the advantages that may be derived, by using alkaline salts instead of lime, are of much greater importance and general utility, inasmuch as the peat, by alkaline salts, is rendered completely soluble; whilst, by the application of lime, no greater proportion of it is made capable of solution than what is equivalent to the quantity of volatile alkali, which may be generated in the process; besides which a large proportion of the acids contained in the vegetable matter, combine with that which is calcareous, and form insoluble compounds." P. 110 to 112.

"The most efficacious method of applying peat to poor barren soils, is to mix it with the urine and dung of cattle; on failure of these articles, with alkaline and other salts, and, lastly, with lime." P. 181.

"Peat soils which acquire unctuous rich clamminess, by the application and action of dung, urine, alkaline salts, &c., in partly dissolving the peat, are the fittest of all soils for the growth of hemp." P. 182.

"From experiments made with alkaline salts and peat, it can be asserted that the effects of such mixture, weight for weight, are equal if not superior to those of dung." P. 183.

"The rendering the inert vegetable matter of peat mosses and fens serviceable to this purpose, though effected at a greater expense than is at present incurred by an application or [of?] dressing to ground, could not fail to answer the expectation of the farmer, and must be considered as one of the most valuable improvements that has hitherto occurred in the annals of husbandry." P. 183.

"The burning of peat for the purpose of procuring its ashes, must undoubtedly appear a very wasteful and dissipating process, when it is considered that there is seldom 1-20 of its weight in ashes procured by combustion. This process throws into the air the 19-20 of peat, which might, by other preparations of it, be made to contribute, in a superior degree, to the purposes of vegetation. The best preparation of peat, when intended for a top dressing manure, is by the addition of alkaline salts, alkaline hepars, or by a mixture of Glauber salt and hot lime with peat. As the soil cannot be injured by the application of alkaline salts, when mixed with a due proportion of peat, the quantity made use of will, in a great measure, be governed by the facility of procuring it and the price of the article, and may, in some measure, be regulated by the quantity of alkaline salts capable of being procured from the combustion of any crop produced from an acre of ground. In no instance the quantity of alkaline salts obtained, will be found to exceed one and a half cwt., unless from cabbages, turnips and potatoes. No restriction nor nicety need, however, be attended to in the use of alkaline salts, except such as have reference to cost, and the comparative beneficial results from the increased produce of the ground." P. 108.

"The consuming, by fire, peat to ashes, is always to be considered as the least productive, and most uneconomical. The most beneficial and productive of these preparations will be found to be—

Peat with dung and urine;
Peat with alkaline salts;
Peat with alkaline hepar;
Peat with Glauber salt and lime;
And peat with lime.

When the soil does not contain a due proportion of calcareous matter, a preference should always be given either to the last, or to the two last of the above preparations, until it shall have received a sufficient supply of an article so indispensably necessary as calcareous matter to the production of sweet herbage, leguminous plants and grain. Hence it is manifest that an economical and frequent application of lime, in moderate quantities, either mixed with peat or other vegetable matter, or even by itself, is greatly to be preferred to those abundant dressings of lime usually given at one time, which cause an action on the soil more powerful and violent than is conducive to, or compatible with a continued state of fertility. In short, lime should be considered in a chemical and medicinal point of view, when so applied, acting as an alterative, corrector and a decompounder; a disengager of certain parts of the animal and vegetable substances contained in soils, and as a retainer and combiner with others; and is not to be regarded by the practical farmer as a substance fit for the immediate food and nourishment of vegetables, like dung, or decayed vegetable or animal matters. For, although calcareous matter, or lime, forms a component part of vegetable and animal bodies, still the quantity that can be obtained from the annual produce of most crops from an acre of ground, will not exceed eighty pounds weight. This fact has been well ascertained, and if proper attention be paid to it, in regulating the conduct of the agriculturist, in the future application of lime, it will prove more satisfactory than all the chemical reasonings adduced in this treatise." P. 116 to 119.

"The ashes of peat, besides the earthy matter, (consisting for the most part of phosphate of lime,) contain likewise phosphate of iron, gypsum, Epsom salts and green vitriol, and those in different proportions, according to the nature of the peat and circumstances under which it had been formed. Hence also the ashes of different kinds of peat will have different effects, when used as manures or top dressings to ground." P. 35.

"Peat is very retentive of moisture, retaining it in a manner similar to that of a spunge." P. 33.

"The longer peat moss is kept exposed to air, the less soluble it becomes, and ultimately imparts no color to water; whilst peat newly formed, or in a less degree oxygenated, imparts a color to water which will be found to contain the extractive saline matters of fresh or less decayed vegetable." P. 35.

"The primary step towards improving a peat moss, is to take off by proper channels, the great feeder of water. This is to be effected by conducting one or more principal drains through the moss, and by water courses on the solid or dry land, immediately above the level of the moss, so that it shall not be inundated by the surface water or springs of the surrounding higher lands, and shall afterwards only require to be freed from the water that shall fall on its superficies." P. 184.

"The alteration in the mechanical arrangement of the soil being effected, the next object is the application of such substances as will bring the peat, or inert vegetable matter, into action. These substances are lime and alkaline salts, which contribute in different ways to the proposed improvement." P. 186.

"Improved peat mosses, bogs, or reclaimed fen lands, are the soils the most productive of luxuriant vegetation, although from this cause they do not in general yield, in this northern and humid climate, heavy and well filled grain." P. 186.

"To top dressings of alkaline salts, and other saline substances, and also to top dressings of lime, either by itself or when mixed with peat or fen mould." P. 187.

"By the dung, and still more so by the urine of cattle, lands of this nature, after having been depastured for a certain number of years, will be found to have received considerable benefit, and to have become more fitted for the production of crops of grain. This is principally to be ascribed to the effect which the volatile alkali of the urine has, in dissolving a proportion of the superabundant oxygenated inert vegetable matter contained in the soil." P. 174.

"The alternate application of dung or vegetable composts, and saline matters, to ground, is the most judicious method to preserve the soil in a state of fertility, and to prevent too great an accumulation of unproductive vegetable matter." P. 175.

"Peat, or vegetable matter, should be carried from the peat moss to the poor soil, and the surface mould from the poor soil to the peat moss. By these means two beneficial purposes may at the same time be effected. The quantity of such like, or other earthy matter necessary to be added to peat soil, to alter the mechanical arrangements of its parts, is to be ascertained by proper trials; and, on the other hand, the quantity of peat requisite to be applied to poor soils, will be regulated by the quantity of vegetable matter which such soils may already contain." P. 180.

Organic matters of Soils.

When vegetable substances decay in soils, they undergo a kind of fermentation and disorganization, and ultimately are converted into acids, which combine with the bases or alkalies and earths of the soil. This result is very different from that which takes place amid pure vegetable matter in bogs, where no bases exist to combine with the acids formed. Hence we find the acids in soils that have a sufficiency of alkaline or earthy bases, are always neutralized by them, and the soil is fertile. But if the soil is siliceous or sandy, there is but little alkaline or earthy matter capable of taking up the acids, and but a small proportion only is neutralized, from whence arises the acidity and barrenness of the soil. It is in vain that green crops are turned in or peat spread on it, if there is a deficiency of the bases. Hence arises the necessity of adding ashes, lime or ammoniacal manures to such soils; animal manures, especially the liquids, answering best for this purpose, and ashes on a light sandy soil, serving both to improve its texture and to supply the alkalies. If the soil is poor in vegetable matters, ashes, lime or ammoniacal salts will serve only for a short time as fertilizing agents, and vegetable manures should be supplied.

Keeping these principles in view, the farmer may act with more certainty of success, in reclaiming a field from barrenness.

In all soils which I have analyzed, and I have obtained them for that purpose from all parts of the world, the following organic matters are invariably present:

1. Crenic acid and crenates of bases;
2. Apocrenic acid, combined also with bases;
3. Humic acid, " " " "
4. Humin, or neutral undecomposed vegetable matter;
5. Extract of humus, and
6. A second extract, not yet named, separated from the above;
7. Phosphoric acid, in minute quantities, combined generally with lime, alumina or magnesia.

The same organic acids have been found by Hermann Berzelius and others, in a number of European soils, so that it may be regarded as certain that all soils contain them, and there can be no doubt that they are essential to the fertility of soils.

Origin of the saline matters of Soils.

The alkaline earthy and metallic bases of the salts found in soils, are traced directly to the mineral kingdom, some of them being derived from the decomposition of the minerals of rocks, and others from the saline contents of mineral waters. The same is true, also, of the mineral acids, such as the sulphuric, muriatic, nitric and phosphoric acids; while the vegetable acids, composed of carbon, oxygen, nitrogen and hydrogen are products of vegetable elaboration of the elements of water and air.

The vegetable acids are valuable as a means of rendering soluble certain earthy matters of the soil, whereby they become capable of entering into the sap vessels of plants, and there undergo such elaboration as may be suited to the wants of the plant. The most

valuable acids are those which contain the largest proportion of nitrogen, and at the head of the list stands the apocrenic acid, which contains 17 per cent. of nitrogen.

It is essential to the durability of a manure, as also to the healthy growth of plants, that manures should not be too soluble, and this acid and its salts, especially its combination with lime, possesses the right degree of solubility, and its aluminous and ferruginous salts yield the acid slowly and gradually to the carbonate of ammonia or to the fixed alkalies, potash and soda.

Saline matters of Plants.

The saline matters having mineral bases, are universally present in all plants, and vary in their proportions in their different parts, as also with the species of vegetable. It will therefore be necessary, in treating of the chemistry of agriculture, to inquire what are the principal saline ingredients of our usual crops, and what do they receive from the soil.

Few agriculturists are aware of the fact that in selling a crop of grain, hay, potatoes, or other agricultural produce, they are actually disposing of a portion of their land, and that the crops contain in them the most valuable saline matters of the soil, the constant removal of which, without renewal, would produce barrenness. It is to chemistry that this important discovery is due, and by its aid we not only know exactly what is removed from the soil, but also how to restore an exhausted soil to its original fertility; and by progressive researches, it will soon be ascertained what changes must be made in any soil, to adapt it to the most fertile growth of any desired crop. This result is in a measure already attained, but still additional researches into the most economical methods of effecting it are required. It is not always the cheapest method to proceed directly in adding a fertilizing agent, but by scientific skill, it may be better obtained by indirect means. Science is needed by the agriculturist, for he cannot know what he is doing without it, and too frequently works in the dark, or merely follows a routine of empyricism which is successful only within narrow limits.

It may be laid down as certain, that all the earthy and saline ingredients of plants are derived from the soil, and those which are constantly found in the most healthy plants may be regarded as essential to their economy, and if the soil is deficient in them, they must be added to it. This can be known only by chemical analysis of the most perfect kind, such as can be made only by the most skillful chemists, gross analyses, such as have been recommended in popular essays, being of no value, but serving only to mislead the farmer. It being so much easier to write dogmatical essays, than it is to make accurate researches, we should not be surprised that ambitious writers have stated erroneous principles, and reasoned from incorrect data. Too many books on agricultural chemistry have been published, that fully illustrate this remark. We may, however, reject the errors and retain what is true in them, if we are sufficiently acquainted with the subject to make a proper discrimination.

Chemical analysis of the Red Raspberry bush, (Rubus strigosus.)

The specimens were taken from land which was cleared and burnt three years ago, and was covered with the raspberry bushes. The question to be solved was, whether

this plant contains an unusually large proportion of the fixed alkalies. This I anticipated would prove to be the case, from the well known fact that this bush springs up wherever a fire has been kindled in the wilderness, and constantly follows the clearing of land by fire. The bushes were obtained from a hill side, in Springfield, N. H., where a clearing by fire had been made, and the land was covered with the luxuriant bushes.

1000 grains of the dry bushes, burnt in a platina capsule, in a muffle, yielded 16.2 fusible ashes of a delicate pink color.

This matter, on analysis, yielded—

Silicic acid, - - -	0.25
Phosphate of lime, - - -	3.65
Carbonate of lime,* - - -	3.40
Potash, - - - -	5.24
Soda, - - - - -	0.50
Oxide of manganese, - - -	1.00
Carbonic acid and loss, - -	2.16
	16.20

The above analysis shows how large a proportion of the elements of these plants is of mineral origin. It also indicates the propriety of putting ashes around our garden raspberry bushes, since they probably require the same elements. It is remarkable, also, that the red raspberry prefers primary or trappean soils, which are highly charged with the fixed alkalies.

Researches on the saline matters of Grain.

The researches made on several cereal grains and on other seeds, demonstrate the existance of certain saline matters which are essential to the formation of those seeds, and on the presence of which their nutritive properties in a measure depend.

Indian corn. When this grain is burnt to ashes in a platina capsule, it is found difficult to burn out the last traces of carbon; for the fusible phosphates and free phosphoric acid envelope the particles, and prevent the admission of the oxygen of the air to the carbon.

While engaged in the agricultural survey of Rhode Island, one of my pupils accidentally converted the bottom of a platina capsule into a brittle phosphuret of that metal, by the action of the carbon of the grain on the phosphoric acid at a high temperature, the reduced phosphorus combining with the platina. This accident led to the discovery of a volatile base in the grain, and to a series of interesting researches on the saline matters.

On burning 100 grains of brown corn, one grain of ashes remains, and was found to consist of phosphates of lime and magnesia, with a little silica, potash and phosphoric acid.

Shepard obtained, by combustion of Indian corn, 0.95 grains of ashes, but no free phosphoric acid.

* This may have been some organic acid salt of lime in the plant, perhaps the malate or oxalate.

He states the composition of these ashes, as follows—

Silica, - - - - -	38.45
Potassa, (with traces of soda,) -	19.51
Phosphate of lime, - - -	17.17
Phosphate of magnesia, - -	13.83
Phosphate of potassa, - - -	2.24
Carbonate of lime, - - -	2.50
Carbonate of magnesia, - -	2.16
Sulphate of lime, and sulphate of magnesia,	0.79
Silica, mechanically present, - -	1.70
Alumina traces, and loss, - -	1.65
	100.00

The quantity of ashes operated upon is not stated, and the processes are not given, excepting those of incineration, in which he failed to form a phosphuret of platinum, which was owing to the free admission of atmospheric air, and of combustion at a low temperature. By burning off the carbon with nitric acid, free phosphoric acid may be readily obtained, as in my experiments.

The chits, or that part of the grain containing the germ, being dissected out and analyzed separately, was found to contain a still larger proportion of the phosphates. 100 grains of the "chits," yielding 6.4 grains of very fusible ashes, which consisted of—

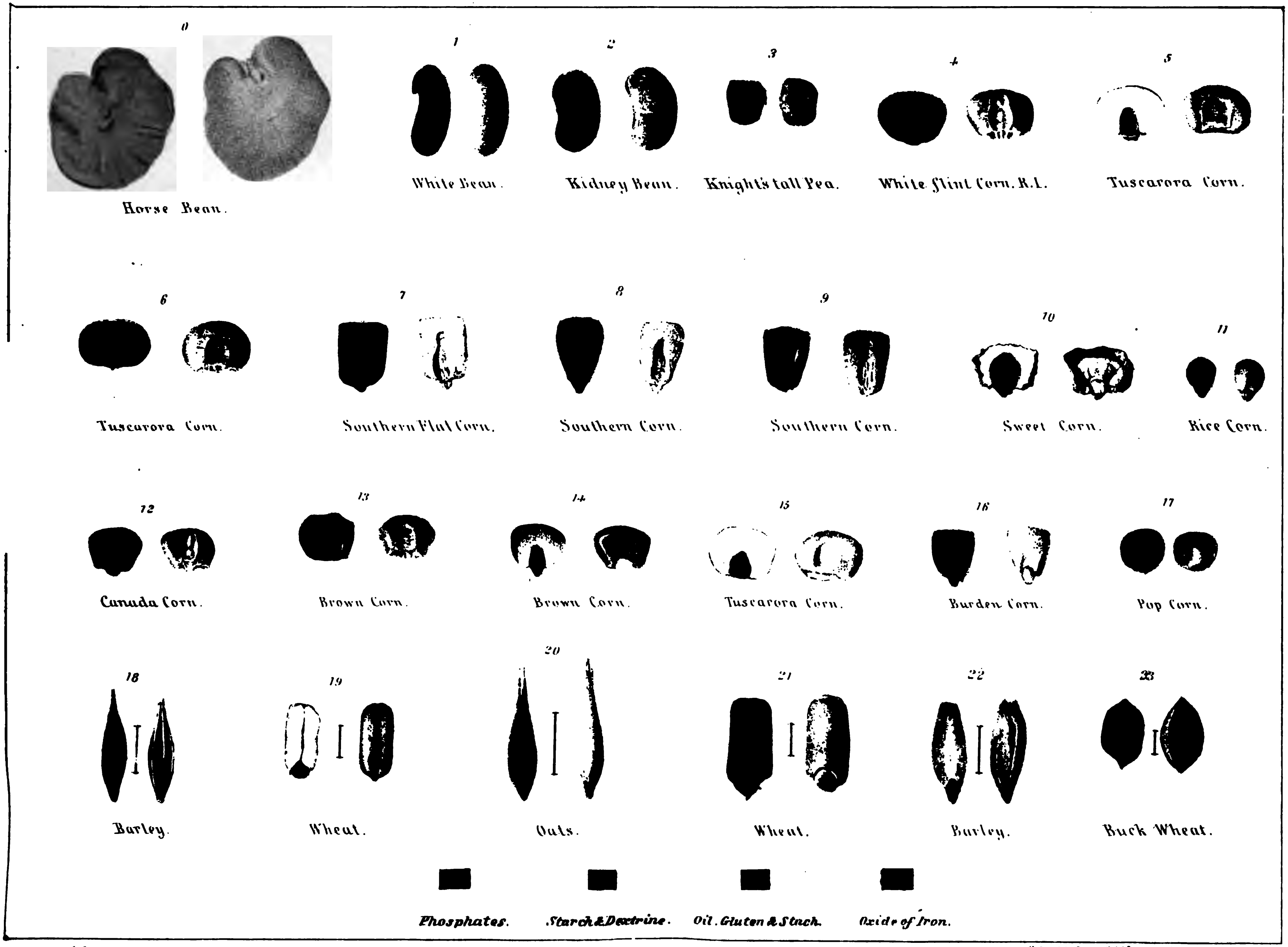
Phosphate of lime, - - -	2.4
Phosphate of magnesia, - - -	0.8
Phosphoric acid, a little silica, potash and oxide of iron, - - - - -	3.2
	6.4

It is evident, then, that the salts are most abundant in this portion of the grain. This was confirmed by an observation made by Mr. A. A. Hayes, who remarked that sulphate of copper colored green the chit and germ only, thereby beautifully defining the limits of the phosphates in the grain, by the formation of phosphate of copper, which thus painted out the limits of the phosphoric acid.

This ingenious method I have since applied to the examination of the seeds of all our usual plants, and to tubers, roots and stems of recent vegetables.

By soaking any seed, after it has been cut open, in a watery solution of sulphate of copper, or blue vitriol, this experiment may be repeated, and the result will give decisive proofs of the presence of phosphoric acid in all but the oily seeds, which do not admit of this test.

A grain of Indian corn split open longitudinally and thrown into a solution of sulphydrate of ammonia, the "chit" is soon changed to a dark olive color, which arises from the change of the salts of iron into a sulphuret of that metal; a black colored matter forming with the ammonia, turns the vegetable coloring matter yellow, and the two colors combined, produce an olive. This experiment was made first by Mr. Hayes, and has been applied by me to every common grain and seed.



C. Cook's Lith. 32 Merch'ts Exchange, Boston

I then prepared specimens of grain by means of tincture of iodine, so as to paint out the limits of the starch and dextrine, the tincture of iodine striking an intense blue with starch, and a deep Port wine red with dextrine ; so that from this test a rich violet indicated the presence of both starch and dextrine in grain. If the oil is extracted from the transparent, horny part of corn, by alcohol or ether, the tincture of iodine will indicate the presence of starch in that part of the grain associated with the gluten.

By these means we may easily cause any grain to paint out the extent and precise limits of each of its ingredients, and by the eye we can form a pretty correct estimate of their relative proportions in different seeds.

This beautiful application of chemistry being new, and nothing having yet been published on the subject, excepting what I have stated to the American Association of Geologists and Naturalists, or have given in the form of lectures before Agricultural and other societies, I have had a colored lithographic drawing made from my specimens and presented to the public in this Report.

It is my intention to publish, hereafter, a more full account of the chemical method of testing plants, with some physiological researches on germination; but the experiments require much time, and are not yet all completed.

Among the curious results of these experiments, is the proof that the relative proportions of phosphates in grain depend on the appropriating power of each species, or variety ; for an ear of corn being selected, which had on it two different kinds; viz., the Tuscarora and the sweet corn, and these seeds being slit in two and immersed in the same solution, soon gave evidence of more than double the amount of phosphates in the sweet corn, than in the other variety. Now, since the kernels came from the same ear, and grew side by side, they obtained unequal quantities of phosphates from the same sap, derived from the same soil. A crop of sweet corn will take twice as much of the phosphates as the other variety, and, consequently, will sooner exhaust the soil of them, and also, if the soil is deficient, will require more phosphates, (e. g. ground bones,) to be added. (See fig. 6th, Tuscarora, and fig. 10th, Sweet corn.)

Some interesting facts will also be noticed in the variable proportions of phosphates in different varieties of the same species of grain, and the great preponderance of them in Indian corn, beyond what is contained in the smaller grains, like barley, oats and wheat ; a fact that seems to explain their peculiar properties as food for animals ; the more highly phosphatic grains being more likely to surcharge the system of adult animals with bony matter, producing concoctions of phosphate of lime, like those resulting from gout.

Perhaps that stiffness of the joints and lameness of the feet, common in horses fed too freely with corn, may be accounted for by this preponderance of the phosphates. Young animals cannot fail to derive more osseous matter from corn than from other food.

Agriculture may learn something from these researches; for they indicate the relative power which each kind of grain possesses in appropriating the phosphates contained in the soil, and consequently its wants.

Buckwheat and oats contain the least proportion, and may be raised on soil which is not fully supplied with phosphates.

Beans and peas are highly charged with the phosphates of lime and magnesia, while

they contain but very little starch. They also contain salts of iron, as indicated by the alteration of their white color to a dirty olive green. Both the cotyledon and the germ are charged with all these salts; but the epidermis or skin of the bean or pea, is free from them.

Relative proportions of Starch in Grain.

Tuscarora corn contains the most. Fig. 5 represents the natural appearance of the grain whole and cut open. Fig. 6 shows by the iodine test, changing it to a violet, that starch and dextrine form the entire mass of the grain, excepting the chit and germ. Rice corn and pop corn contain the least starch. The other figures sufficiently explain the relative proportions of all the ingredients of the grain they represent.

Relative proportions of Oil and Gluten.

Rice corn contains the most oil. Pop corn, Canada corn and Brown corn rank next. Burden corn is charged with a very fine white oil. Tuscarora corn does not contain oil or gluten. It will be remarked that there is a great difference in the mode of distribution of the oily and glutinous parts of corn; the southern variety always having it on the sides of the elongated seed, while the starch projects quite through the grain to its summit, and by its contraction in drying, produces the peculiar pit or depression in this variety of grain. The Burden corn is still more remarkable for this arrangement.

Popping Corn.

The oil in the horny portion of the grain is contained in little six-sided cells, in the form of minute drops, visible in a thin section under a good microscope. When a grain of corn is heated to a temperature sufficient to decompose the oil, a sudden explosion takes place, and every cell is ruptured by the expansion of gaseous matters arising from the decomposition of the oil, and the grain is ruptured at the weakest point in the arch, and is completely evoluted and folded back. Now on examining the cells again, they will be found lacerated and swollen much out of shape.

If an attempt is made to pop Tuscarora corn, it will be found never to succeed; hence, I was able to prove that this curious phenomenon, so familiar to every child, though never understood by their parents, is due entirely to the decomposition of oil and the formation of carbureted hydrogen gas, such as is sometimes used in lighting large cities.

This change in the corn is one of considerable importance, so far as regards facility of digestion; for it is much more digestible by man, after this decomposition and extinction of the oil, though not so fattening to animals that can digest oil. The use of the oil in corn is obviously to prevent the rapid decomposition of the grain in the soil, and to retain a portion of food until needed by the young plant, and is always the last portion of the grain taken up.

It serves to keep meal from souring readily, and it will be observed that a flint corn meal will keep sweet for years, even when put up in large quantities; but the Tuscarora meal will sour in a short time. The latter is the most digestible grain for horses,

and is soft, but it is of little value for feeding swine. It is a good kind of grain for rapid cooking, for its meal is quickly boiled or baked.

Oily corn makes a dry kind of bread, and is not adhesive enough to rise well, without admixture of rye or flour. Rice corn is so dry that alone it will not make bread, but is dry like sand.

Oily grains are excellent for fattening fowls, and the rice corn, both from its size and oily nature, is admirably adapted for them.

Corn is sometimes raised for the manufacture of whiskey, and the oil is saved during the fermentation, since it separates and rises to the surface. I have been informed that 100 bushels of corn yield from fifteen to sixteen gallons of oil. It is made on the borders of lake Ontario, and has been used in the lighthouses on the lake.

According to my analysis, the proportions of oil in Indian corn vary from six to eleven per cent., the latter being the yield from Canada corn; while rice corn contains still more, but has not been fully examined.

Southern corn has more starch and less oil than our northern flint corn, and is much softer and better food for horses, though not so fattening for swine or poultry, and is, when ground, more apt to become sour.

When Indian corn is hulled by means of potash lye, the oil next to the epidermis of the grain is converted into soap, and the epidermis is detached. The caustic alkali also liberates ammonia from the mucilage around the germ.

Sweet corn appears like an unripe grain. Its origin is unknown; but it appears to have been used by the aboriginal inhabitants of New England, anterior to the settlement of the country by the pilgrims.

It is a remarkable variety of corn, containing, as before observed, an unusually large proportion of the phosphates, and a large quantity of sugar and gum, with but little starch.

Its excellence for food in its green state is well known and appreciated, and having stalks which are short and slender, they of course take up a less proportion of the saline matters of the soil.

The colors of Indian corn depend on that of the epidermis, or hull, and of the oil, the latter, when yellow, showing its color through a transparent epidermis; while if the hull is colored and opaque, the grain presents the same color.

In the Rhode Island white flint, (a favorite grain in that State,) the oil is transparent and colorless, and the epidermis is likewise free from color and is nearly transparent; hence, the meal is white, and the quantity of oil being large, it is less liable to ferment and become sour than some other varieties, and is in very good repute.

The yellow color of the golden Sioux, a twelve rowed kind of corn, is due to the color of the oil.

Brown corn has a darker color, dependent on the combined colors of the oil and epidermis.

Red and blue corn owe their lively hues to the colors of the epidermis, and not to the oil.

On inspecting very thin slices of corn, by the aid of a good microscope, the epidermal

coat is found to be made up of hexagonal cells, sometimes much elongated and much larger than those of the glutinous and oily parts of the grain.

The starch globules are seen distinctly in the starchy part, and are smaller than those of the potatoe, and more rounded. A drop of dilute tincture of iodine brings out their forms and character most beautifully.

No crystals of saline matters are seen in the grain; but the phosphates are probably in the state of a fine powder, while the ammonia is in combination with the organic matters, forming a kind of *amide* in the mucilage around the germ.

Indian corn, according to the analysis of M. Payen, consists of the following ingredients. 100 parts, by weight, yielded—

Starch,	28.40
Nitrogenized matter,	4.80
Fat matter, (oil,)	35.60
Coloring matter,	20
Cellular tissue,	20.00
Dextrine,	2.00
Various salts,	7.20
	98.20

The proportion of oil is evidently overrated in this analysis, and the error is due to the solubility of the lime or gluten of Indian corn in ether, which Payen used to dissolve the oil. The gluten being taken up by this process, was mistaken for oil, and credited in the analysis as such, when it should be put under the head of nitrogenized matters.

It is not surprising that M. Dumas, in quoting this analysis, should observe that "indidividuals who eat corn for some time, present symptoms of an accumulation of fat in their tissue, which will not appear astonishing, when we consider that a bushel of corn would yield a quart (litre) of oil!" Our New England farmers, then, ought to be an excessively fat people, according to this theory, if they did not work it off into hard muscular fibre!

Dumas says that the popping of corn is due to the conversion of the water contained in the starch, into steam, which I have shown to be an error, and proved this phenomenon to arise from the rupture of the cells of the glutinous part of the grain, by the conversion of the contained globules of oil into gas.

Indian corn is not sufficiently well known in Europe, and is not properly valued. In England, the climate is not sufficiently warm in summer to allow it to ripen; but green corn can be abundantly raised, and if known, would be valued as a luxury. In the south of France and in Venitian Lombardy and in Tuscany, abundant crops of Indian corn are raised; but it is used only by the poorer classes and for feeding cattle, absurd prejudices having prevented its general use among the higher classes of the people.

"All animals that are not exclusively carnivorous will eat Indian corn, and generally prefer it to other grain." It certainly is in the highest degree nutritious.

The cultivation of corn gives a peculiar character to New England husbandry, it being a hoed grain crop unknown in England.

A grain of corn is a fruitful topic, and might profitably occupy a large space on these

pages; but what has already been stated, may serve to show the degree of interest attached to a single agricultural product, and convince agriculturists that they have abundant objects of study around them.

It is obvious that the ingredients above described as components of corn, are all essential to a highly nutritious grain.

The gluten and mucilage contain nitrogen, an element essential to the formation of fibrous tissue, muscles, nervous matter and brain.

The oil is ready formed fat, easily convertible into animal oils by a slight change of composition.

Starch is convertible, also, into fat and into the carbonaceous substances of the body, and, during its slow combustion in the circulation, gives out a portion of the heat of animal bodies; while, in its altered state, it goes to form a part of the living frame. Sugar acts in a similar manner, as a compound of carbon, hydrogen and oxygen.

From the phosphates, the substance of bone and the saline matters of brains, nerves and other solid and fluid parts of the body are, in a great measure, derived.

The salts of iron go to the blood, and there constitute an essential portion of it, whereby it is enabled, by successive alterations of its degree of oxidation during the circulation through the lungs, arteries, extreme vessels and veins, to transport oxygen to every part of the body.

These remarks apply also to the other cereal grains and, in part, to leguminous seeds.

It is evident, then, that grain contains all the elements required for the perfect developement and support of the bodies of animals, and that even when we consume animal food, we obtain the same ingredients, some of which are presented in a more concentrated form; but they were all originally derived from vegetables, and are but little changed in nature in animals.

From the modern researches of French chemists, it is evident that "flesh is grass," in a more strict sense than was formerly supposed—Dumas having demonstrated that vegetable fibre is of the same composition as animal fibre; vegetable albumen identical with animal albumen; caseine, or the basis of cheese, also of the same composition as legumin of beans, pease and other plants; while, at the same time, a kind of cheese was made from beans.

The identity of composition of vegetable and animal proximate principles, leads to some very remarkable conclusions, and it is now laid down by the French chemists that plants are the exclusive producers of the proximate principles, common to both them and animals, and that animals never produce any of them, but only appropriate those previously formed by plants.

Plants, says Dumas, are organs of reduction; animals are organs of combustion.

VEGETABLES produce neutral nitrogenized matters;
" " fat matters;
" " sugar, starch and gum;
" decompose carbonic acid gas;
" absorb heat;
" " electricity;
" are an apparatus of reduction.

ANIMALS consume neutral nitrogenized matters;
" " fat matters;
" " sugar, starch and gum;
" produce carbonic acid gas;
" give out heat;
" give out electricity;
" are an apparatus of combustion. (*Dumas et Cahours, Memoir sur les Matieres Azotes neutres de l'organization*, 28*th Nov.* 1842, *Paris.*)

Some remarks on the Improvement of Soils.

To reclaim a soil from barrenness, or to improve one of moderate fertility, requires an insight into the nature of the agents most active and universally present in fertile soils. The appended analyses shew the usual ingredients, in their various proportions, and, by inspecting them, the nature of soils will be understood. The ingredients which occur in the most minute proportions, are those on which the fertility of a soil depends; and hence, the folly of recommending rude analyses will be obvious, for only the most skillful chemist can analyze a soil in a proper manner.

A thorough chemical analysis is a long, tedious and exceedingly delicate work, and it is not probable that many such analyses will be made, excepting in cases of importance, where a question of science is involved. From a few such analyses we must derive our general rules of treatment of soils.

Silica, alumina, lime, magnesia, oxide of iron, oxide of manganese, potash, soda, phosphoric acid, sulphuric acid, chlorine and a certain proportion of disorganized and partially decomposed organic matter, appear to be the most common and universal constituents of soil. But the state in which these bodies are combined, and the condition of the organic matters, decide, not unfrequently, between barrenness and fertility.

Light sandy loams need a heavy top dressing of leached ashes, after which they will produce abundant crops, some of which may be turned in, to augment the proportion of vegetable matter; or the latter may be obtained by making a compost of swamp muck, or peat, with animal manures, both liquid and solid, and mixing in lime previous to spreading it, and harrowing it in.

When a soil is properly charged with a limed compost, gypsum, or plaster of Paris is an excellent fertilizer, and should always be sown broad cast, with clover, and serves to retain the ammoniacal matters disengaged from nitrogenized manures by the action of lime. When the soil is too sandy and is subject to loss of manures by leeching, or infiltration, the retaining properties of the soil may be much improved by adding a top dressing of clay, which it is best to half burn by means of a fire of faggots, or peat, placed in the heap for the purpose. A much less proportion of clay is required for the improvement of a sandy soil than is required of sand for a clayey one, a very little clay giving a considerable retentive power to sand. Burnt clay also yields potash, which is a fertilizer to sandy soils. Clay soils may be underdrained, and may be improved by burning a part of the clay and replacing it, so as to give the soil more porosity. Dundonald remarks—

"On this practice, (as it were,) of making a soil, it is necessary to state, that much less

expense is incurred, and more benefit received, by adding clay to a sandy soil, than adding sand to a clayey soil." P. 170.

"Paring and burning the sward of some clayey soils may be practised with advantage, as the burnt clay will diminish the stiffness of the soil, and render it more pervious to water. This may be still more economically effected, and, in other respects, with less injury to the soil, by half burning the clay in clamps, or in kilns. A preference can only be given in situations where fuel can, at a cheap rate, be procured for this purpose." P. 165.

"Underdraining at this time is very decidedly in great estimation, and is becoming the general practice. It saves much waste of ground, more completely answers the intended purpose, is of longer duration, and ultimately less expensive than any other kind of draining. A method has lately been discovered, and practised with success, by which, in many places, the upper stratum is drained by the assistance of the mineral strata beneath it, through which the water is made to drop, and in this manner taken from the surface." P. 143.

"What is most important to be done, should ever be done first, and the attention of the farmer should not be called away to other objects, such as the irrigation of meadows, until he has relieved his lands of the injurious surface water, and laid them sufficiently dry; previous to which, the full benefit that may arise by irrigation, or the judicious application of water at certain seasons, cannot be expected." P. 142.

Pulverized granite is a good amendment to clayey soils, and gravel may serve the same purpose.

When there is a deficiency of lime on a soil, it may be supplied by a top dressing of marl or air-slaked lime, or still better by a compost manure, made of peat and animal matters, and heavily limed previous to spreading on the soil. Ground bones, or bone ashes are excellent fertilizers, and are needed by most of our soils from primary rocks.

The alkalies, potash and soda, are best introduced in the form of ashes, or in a peat compost. They are needed in light sandy soils, and in those having acid vegetable matters. Ammonia is too expensive a manure to be used directly in the treatment of soils; but is easily produced by indirect means from animal matters, and especially from urine. It may be absorbed by the organic acids of peat, or by means of a mixture of peat and ground plaster of Paris, which will take up an enormous quantity of ammoniacal gas, in the state of sulphate of ammonia and apocrenate, humate and crenate of ammonia, all of which are powerful fertilizers.

Magnesia is never used directly as a manure, and would probably act unfavorably; but when combined with phosphoric, or sulphuric acids, it forms a most valuable salt, highly fertilizing, and applicable to all kinds of soil in New England. When a magnesian limestone is used in a compost with peat and animal liquid manures, phosphates of magnesia and lime are formed, and they act favorably on vegetation.

"Magnesian earths may be applied with peculiar advantage to soils generally, and not improperly called sour soils, containing green vitriol, arising from the decomposition of pyrites. It will decompose the metallic salt by superior affinity, and form with the acid, Epsom salt, known to promote vegetation in a high degree; while the earth of iron will be separated in the state of an ochre, or iron combined with fixable air." Dundonald, P. 51.

A mixture of peat, urine, a little Epsom salts, lime and gypsum will make an excellent fertilizer to almost all kinds of soil.

In reclaiming peat bogs, fine micaceous loam, or subsoil, is very useful, and a covering of one fourth of an inch on a peat bog that has been thoroughly drained, will enable it to bear a good heavy crop of English grass, particularly of herdsgrass, which is admirably suited to reclaimed bogs.

A top dressing of lime may also be liberally spread on any bog, and will improve it. Leeched ashes are also valuable for top dressing; but the bog must be well drained before they are spread, or much would be lost by solution in water, and the bog will not be sufficiently warm. In peat, containing alum and copperas, which are both deadly to plants, a heavy dressing of lime, ashes, or of urine, will completely remedy the difficulty, and render the bog exceedingly fertile. The same treatment is also required when acid peat is used in making composts. Raw peat should never be put on any soils, unless they are highly calcareous, which is never the case in New England. The improper use of peat has excited prejudices against it, which will be removed by more skill and experience.

The use of plaster of Paris, or gypsum, as a manure, has long been known in this country, its value having been demonstrated by Franklin, who is said to have traced with gypsum, on a clover field, in large letters, the words, "Effects of Plaster," which were distinguishable for some years by the rankness of the grass where the plaster had been spread. It is used with advantage in the hills with potatoes, much improving the tubers and increasing their size. In one case where I examined into a trial of gypsum, the potatoe crop was found to be increased one third by sprinkling a table spoonful of it in each hill.

It has but little action in the soils on the sea coast, probably because salt has the same effect, and supersedes it. Gypsum enters into the composition of clover and some other plants; but its action is probably more generally an indirect one, though it is not yet fully understood. The sulphuric acid of gypsum takes up the ammonia of the carbonate of ammonia, formed by the decomposing animal matters, and sulphate of ammonia results; while the carbonic acid takes the lime of the gypsum and forms carbonate of lime. The carbonate of lime thus formed, again reacts on decomposing vegetable matters, forming acids, and the lime and acid combine, forming a crenate, apocrenate or humate of lime; and while the carbonic acid extracted from the carbonate of lime goes to nourish the foliage, the organic salt of lime enters the rootlets and goes into the circulation of the plant.

Use of Salt.

Salt acts as a powerful fertilizer, especially on soils remote from the sea. It causes an increased growth of the foliage and gives the plant more strength, so that a much larger crop of grass is obtained where salt has been spread. It should not be used in larger quantities than from 300 to 400 pounds to the acre, and it is best to mix it into the compost while adding the recently slaked lime; for it will serve to retain the ammonia, acting in the same manner as gypsum, while the ultimate action of the lime upon it will be to generate carbonate of soda, a powerful alkaline manure and solvent for peat. Salt is used advantageously in raising asparagus and turnips, and may be applied pretty liberally to the

former, with perfect safety. Salt is spread in the state of small crystals, or in powder, on grass lands, and may be put on at two separate times during the growth. Le Coq says that 300 pounds of salt produced the same effect as 5000 pounds of gypsum; but its solubility must prevent its acting through more than one or two seasons, while gypsum lasts for many years.

Muriate of Soda, or Sea Salt.

"Its fertilizing powers have been highly extolled by some, whilst others have positively denied its efficacy. It is destructive to many different kinds of living insects, such as snails, grubs, slugs, worms, &c. Sea salt is extremely injurious to poor soils, and ought only to be applied to rich lands." (Dundonald, p. 86.)

Epsom salts or sulphate of magnesia, is a good manure and may be used both on grasses and potatoes with good effect.

"Dr. Home of Edinburgh, made use of it in 1795, and found it increased the crop of grain about one fourth." (Dundonald, p. 69.)

Nitre.

All the nitrates or combinations of nitric acid, with alkaline and earthy bases, are good manures, nitrates of potash and soda being the most valuable. Nitre is very soluble, and is a transient manure, especially when used on very open soils. It is very useful in retaining moisture, and a wet spot may be observed wherever a crystal of saltpetre is laid.

Nitrate of soda is more soluble than nitrate of potash, and hence is not quite so permanent.

Nitrate of lime and nitrate of magnesia are exceedingly deliquescent, attracting water with the greatest avidity, and have the property of retaining moisture in the soil.

All the nitrates are active manures, and saltpetre is an ingredient in the juices of some of the plants, being obtained by evaporation of the exposed juices of the pumpkin vine.

Nitrate of Potash, or Saltpetre.

"This salt is very soluble, formed by the putrefaction and complete decomposition of animal and vegetable substances; when mixed with calcareous matter and wood ashes, it promotes vegetation, but its high price precludes it being used as a manure." (Dundonald, p. 84.)

Nitrate of Soda, or Cubic Nitre.

"This salt is likewise very soluble, but seldom naturally occurs. It is probable that cubic nitre would promote vegetation in an equal degree with nitrate of potash or saltpetre." (Dundonald, p. 84.)

Phosphates.

Phosphates of soda, potash, magnesia, ammonia and lime, are all powerful manures, and enter largely into the composition of plants. Phosphate of lime is the most abundant,

and is readily obtained from burnt bones, which are mostly composed of it. Phosphate of potash or of soda may be formed from bones, by boiling bones with bi-sulphate of potash or acid sulphate of soda; this being a convenient method of reducing the bone to sulphate of lime, while the phosphoric acid is taken up. The bones should be first deprived of grease by means of caustic potash, which forms a soap. The phosphates and sulphates may by used in their mixed state in compost; but if there is any excess of sulphuric acid, it must be neutralized by potash or lime.

Phosphate of Potash, of Soda and of Ammonia.

"Phosphoric acid and alkaline salts are contained in the ashes of vegetables; these salts, or their primary principles, must necessarily have constituted a part of such vegetables, from which it may be inferred, *a priori*, that alkaline phosphates are conducive to the growth of plants. Alkaline phosphates are to be obtained by the addition of alkaline carbonates, or mild alkaline salts, to oxygenated peat, or other oxygenated vegetable substances, forming therewith a reddish brown mucilaginous compound." (Dundonald, page 88.)

Phosphate of Lime.

"There is reason to believe a very considerable proportion of this nearly insoluble salt is contained in most fertile soils, especially those that have been long under cultivation." (Dundonald, p. 75.)

"These alkaline phosphates will be found to promote vegetation, in a very great degree; the substances of which they are composed, viz., alkaline salts and phosphoric acid, are found in the ashes of most vegetables." (Dundonald, p. 75.)

Sulphate of Potash, or Vitriolated Tartar.

"This salt is soluble in fifteen times its weight of cold water, and has been found, by Dr. Home, to promote vegetation in an extraordinary manner. The garden mould on which his experiments were made, produced an increase of one fourth more grain, in consequence of the application of this salt. Vitriolated tartar is to be had from most vegetable matters by combustion; it forms at least one-third of the saline matter obtained by the lixiviation of their ashes. This is sufficient, *a priori*, to prove, (independently of Dr. Home's very satisfactory experiments,) that vitriolated tartar is beneficial to vegetation. This substance is a refuse article in some branches of manufacture; but the quantity produced is a mere trifle, in comparison to the quantity that might advantageously be applied to the purposes of agriculture." (Dundonald, p. 82.)

Mr. Levi Bartlett of Warner, has made use of the black salts which remain in potash kettles, during the manufacture of pot or pearl ashes. They consist of impure sulphates of potash, and decompose bones very quickly. The bones are to be broken up coarsely and then are to be boiled in the saturated solution, until they fall to powder, and then the whole is to be thrown into the compost heap. By a little chemical skill, the farmer may make a great number of valuable saline manures, and the work may occupy that portion of the year, when he is least engaged in farming operations.

Mr. Bartlett has set a praiseworthy example to his fellow citizens, in beginning this kind of work, and his success will cause others to imitate him.

Sulphate of Ammonia, or Vitriolic Ammonia.

"This salt is very soluble, and promotes vegetation; but it is not to be had in such quantities as to render it an article of importance to agriculture." (Dundonald, p. 83.)

"Soot is used in many parts of Britain, with very beneficial effects, for the destruction of the wireworm and other insects, which prey upon the young tender leaves and roots of plants. This article, exclusively of carbonaceous and earthy matters, consists of resinous oil, rendered capable of solution in water by the saline matters, which are contained in soot in great abundance. The solution is an extremely bitter, high colored oily liquor, which not only poisons the insect on which it may fall, but also communicates a bitter taste to the surface of the roots and leaves of plants, thus rendering them unfit for the food of such insects. The effects of soot are not confined to the destruction of insects alone; for the resinous bituminous oil, dissolved by the saline matters, promotes the growth of plants in a very high degree, and by rapidly pushing them to an advanced state of maturity, allows no time for the ravages of insects on the young and tender roots and leaves of plants, on which, in general, they principally feed." (Dundonald, p. 139.)

"Land is always requiring a supply of manure, and repays in general more abundantly for the last expense, when brought to an advanced state of cultivation, than for that which at first is incurred. Both seed and labor are thereby saved, and good crops, with much more certainty, are to be depended upon." (Dundonald, p. 164.)

Stable, Farm Yard Dung, and Composts.

"Although it is a common saying in Scotland, 'that muck is the mother of the meal chest,' still there is no country where the preservation of the urine of cattle and the juice of dung heaps is so little attended to; or where the farmers, in general, are at so little pains to procure the greatest quantity of an article so indispensably necessary to the obtaining of abundant crops." (Dundonald, p. 90.)

"Did the conveniences attached to a Scotch farm, allow the industry of the tenant to be exerted in preserving the urine and dung of his cattle, by constantly bedding them with, or mixing their urine and dung with dry peat, or when this substance is not to be procured, with rich black mould, the consumption of all the straw by cattle would, in such case, be found to be a practice highly conducive to the interest of the farmer." (Dundonald, p. 94.)

"By a flooring of clay or chalk under the pavement of the stables, outhouses, &c., the urine of the cattle will be prevented from sinking through, and by the same precaution the valuable juices of the dungheap may also be prevented from soaking into the soil of the farm yard, especially if due care be taken to add from time to time a sufficient quantity of peat, or rich black mould, to absorb or suck up the surplus moisture produced by the succulent food." (Dundonald, p. 128.)

"They, (farmers,) should understand the properties and effects, and superior affinities of

alkalies and acids; as well as the names, properties and compounded elective attractions attendant on the mixture of the different neutral salts, and their effects on vegetation. They should be well acquainted with the powers of lime, and should distinctly and clearly comprehend the putrefactive and oxygenating processes, as well as the consequences resulting from the action of fire on the vegetable matter contained in the soil." (Dundonald, p. 152.)

"Thus, by a thorough knowledge and application of chemistry to agriculture, the several substances in soils may be made to undergo a varied change of new combinations, tending to promote the greatest of all objects, a more plentiful supply of food." (Dundonald, p. 58.)

AGRICULTURAL OBSERVATIONS.

Visit to Cow Island, in Winnipissiogee Lake.—Derby Farm.

Sept. 21, 1840. This day we visited the Derby farm, on Cow island, in Winnipissiogee lake, in company with Mr. Foster of Boston, who kindly loaned us his pleasure boat for the purpose.

With a fresh breeze, rapidly increasing in strength, we quickly made the voyage from Centre Harbor, running down by the shores of Long island, and having in full view the magnificent scenery which borders the lake on all sides. Landing upon the shores of Cow island, we met Capt. Pillsbury, the skillful farmer who had charge of the estate, and with him visited the corn fields then laden with a rich harvest, and he fully explained his improvements, both in the field and the dairy.

The natural soil of this island is rocky, but strong, sweet and retentive of manures. The top soil is a brown loam, and the subsoil, bright yellow, with a hard pan at some depth. (See analysis of this soil in Analyses of Soils, marked B, in Appendix to Agricultural Geology.)

Capt. Pillsbury's method of cultivation is to manure heavily, broadcast, and to raise first a crop of potatoes, which is followed the next year by a crop of corn; then he sows wheat, and lays the land down to grass. He puts on 28 wagon loads, (of 45 bushels to the load,) to the acre. His corn crops are very large, and the yield is so much greater than is usual in the State, that it would be difficult to persuade farmers generally of the fact, if it had not been fully proved by a committee, that he had raised, during the last year, 130 bushels of good sound corn to the acre. This has been fully substantiated, and extraordinary as was this crop, he lost the premium, being surpassed by his neighbors on Long island, who raised 131 bushels and 7 quarts to the acre, and obtained the agricultural prize for the largest crop. This year he has weighed a crop of corn, and found it to amount to 9216 lbs. of ripe ears of corn to the acre. He estimates 75 pounds as equal to 1 bushel. He says that Mr. Brown of Long island estimated 68 3-4 lbs. to the bushel, in his crop last year.

Capt. Pillsbury raises the variety of 12 rowed corn called the golden Sioux, and Mr.

Brown, the 8 rowed variety, known by his name. The land taken up year before last was dressed with 16 loads, of 45 bushels each, of barn yard manure, per acre, and planted with potatoes, and a good crop was obtained. Then he spread 20 loads of manure on each acre of this land, and planted corn, and obtained 130 bushels, as before stated. His wheat crops on an average have been 34 bushels to the acre, for the last 7 years. His largest crop was 41 bushels to the acre. This year the wheat crop was not so good, on account of the season. He uses lime freely on his land, and thinks it prevents smut in the wheat, as he has none in his crops. His crop of oats was the most remarkable, amounting to from 62 to 94 bushels to the acre. It is the black variety of oats, and weighs 34 pounds to the bushel. His grass crops yield from 2 to 2 1-2 tons of hay per acre, but this year the crop is short, owing to drought. This year he planted his corn on the 18th of May, and began harvesting on the 14th of September.

He thinks high manuring the most profitable method of farming, and is enabled to keep his land in good heart by having an abundance of stock, the principal object of attention being the dairy, and 40 good cows of the Albany and Devon breeds being kept on the farm for their milk. I was informed that some of the cows gave 47 lbs. of milk per day, being milked morning and night. In summer the cows are kept out to grass, and are driven up to the yard to be milked. A few hogs and sheep are kept, but they are not raised for sale.

The following is an account of the butter and cheese made on this farm:—

	Butter.	*Cheese.*
In 1835,	1352 lbs.	7541 lbs.
1836,	1475	6596
1837,	1374	5717
1838,	2803	4585
1839,	2471	6016

No small share of credit is due to Mrs. Pillsbury, for this productive dairy.

On the farm two hired men are employed, and assist in the farming operations. Capt. Pillsbury has lived on this island 15 years. The farm was purchased by E. H. Derby, Esq., of Boston, six years ago, who entrusts its management to a cultivator whose industry and skill deserve the highest praise, and whose example should be followed by those who are ambitious of producing the heaviest crops on the least quantity of tilled land. It would be better, perhaps, for farmers generally, if their farms were islands of not more than 150 or 200 acres, so that they might concentrate the manures of their barn yards within more reasonable limits, instead of spreading it over a great space, and thereby failing to obtain good healthy crops.

After dining with the good farmer of Cow island, we took our boat and rowed over to Long island, and visited the farms of Messrs. Lamprey and Brown, who are skillful competitors of the Cow island farmer. We found them in the corn field, engaged in harvesting a handsome crop. Mr. Lamprey is the farmer who took the premium last year for 131 bushels 7 quarts of corn per acre. Mr. John Brown is a skillful farmer, and has acquired celebrity throughout New England, for a particular variety of 8 rowed corn, which he has produced by a peculiar method, from a small variety raised in Poplin. Long island

comprises 12,000 acres of land, much of which is a good arable soil, which is not yet entirely cleared.

Mr. John Brown's farm is on the south end of the island, and consists of 200 acres. He had 8 acres in tillage, 4 of which was new land.

The soil is good yellow loam, and when cultivated, becomes warm and retentive of manures. The subsoil is yellow, and is underlaid by hard pan. Two specimens of this soil were taken for analysis, and the results of the analysis are given in this report. One specimen was from a highly cultivated field and the other from a cold, infertile patch, planted with potatoes. (See Analyses of Soils, marked B, in Appendix to Agricultural Geology.)

Mr. Brown states that his average corn crop is 80 bushels, and the largest measured crop was 136 bushels to the acre.

Last year he weighed his whole crop and found it to be as follows, per acre—

8051 lbs. of ears of corn weighed=70 lbs. to the bushel.

12 lbs. weight of cobs per bushel.

58 lbs. weight of the corn per bushel.

He spreads 40 loads of barn yard manure per acre, in preparing the land for corn.

Previous to the corn crop he raises potatoes, spreading 17 loads of barn yard manure on the land, and obtains from 300 to 400 bushels of potatoes per acre. His wheat has not done well this year, yielding but 17 bushels per acre, while his usual crops are from 30 to 40 bushels. The Siberian wheat is preferred to the Tea wheat, as it is less liable to smut and rust. It weighs 60 lbs. to the bushel, and is plump, sound and thin skinned.

His oat crops average from 50 to 60 bushels per acre.

The rotation of crops on this farm is, 1st, potatoes; 2d, Indian corn; 3d, wheat, and then lay down to grass, and keep it for mowing until bound out, say 6 or 7 years.

The hay obtained averages 1 1-2 tons per acre.

20 head of horned cattle are kept on this estate, comprising 6 or 7 milch cows. Mrs. Brown makes from 600 to 700 pounds of cheese per annum.

A dozen sheep and 3 hogs constitute the rest of the live stock.

Corn is planted 19th of May, and harvested towards the end of September. The corn is known as the brown corn, and was produced by cultivating selected ears from a variety raised in Poplin. The best ears are selected from the second that are ripe, and the best are taken from those stalks which bear more than two ears each. This corn ripens a little later than the golden Sioux, but is very prolific. In Mr. Brown's fields most of the stalks had more than two ears on them. He allows but three stalks to grow in a hill. The hills are 2 feet by 3 feet apart. I observed that a mixture of the large brown corn and golden Sioux had been made, and varied from 10 to 12 rows, and possessed the good qualities of both varieties. The grains of the brown corn are large and the cob small, and the ears are from 10 to 13 inches in length, and are 8 rowed. The golden Sioux has smaller grain and larger cobs, but is 12 rowed, and the ears are shorter than those of brown corn. Hence it is evident that a mixture might improve the most valuable qualities of each, and this has obviously been effected in a complete manner both by Mr. Brown and Mr. Lamprey, his neighbor.

On Mr. Lamprey's farm the soil is of the same kind as that just described, and the method of cultivation the same.

The mixture of the two varieties of corn above mentioned has been more fully carried out by Mr. Lamprey.

This farm, as before observed, took the premium last year.

The crop, at present harvesting, is certainly a noble one, as is also that on Mr. Brown's farm.

Excepting the favorable influence of the water in moderating the temperature and retaining a little more moisture in the air, I could not perceive that there was any more natural fertility to be expected from these island farms, than from those on the main land. The soil is no better than it is in hundreds of other places in the State, and I attribute the abundance of the crops to high manuring, and great attention to the land and the crop. If farmers elsewhere were as ambitious of excellence, I doubt not many other cases of like success might be recorded.

On attempting to leave the island we found the wind so violent that it was impossible to row the boat against it, and accepted the polite invitation of Mr. Brown to spend the night at his house, where we remained until the next day, and then rowed up to Centre Harbor, against a very strong head wind and short chopping sea, that bespattered us most freely.

On reaching the hotel of Mr. Coe, we obtained some statistical information from him respecting his farm, and took specimens of soil for analysis. He raises a brilliant red corn, and obtains from 60 to 80 bushels per acre; but he does not manure the soil so freely as the island farmers.

His potatoe crop has frequently amounted to 600 bushels per acre; they were the long red and lady finger varieties.

Three specimens of the soil, furnished by Mr. Coe, were analyzed and are reported in this work. (See Analyses of Soils, marked B, in Appendix to Agricultural Geology.)

I have no doubt that a much larger crop of corn may be raised on these soils, by following the plan of Capt. Pillsbury and Mr. Lamprey.

Subsequent to this visit I again visited the north end of Long Island, and examined the estate of Mr. J. S. Boody, collecting the statistics and obtaining specimens of the soils, which have been analyzed, and are reported. (See Analyses of Soils, marked B, in Appendix to Agricultural Geology.)

A letter from Mr. Boody, giving an account of his farming operations, will be found, marked C, in the Appendix to Agricultural Geology.

Shaker's Farm, Canterbury.

On visiting the farm of this industrious community, I was highly gratified to find the Trustees were much interested in modern improvements in agriculture, and having pointed out to them the best methods of making peat composts, and of reclaiming bogs, I visited an extensive morass on their estate, and suggested methods of reclaiming it and rendering it fertile. It was an extensive tract, perfectly barren, and, in many parts, there was so much copperas and alum in the peat that even the mosses and wild grasses were killed by

them, insomuch that the surface looked like copper grounds, and alum and copperas crystalized on the mud that was thrown up, where a ditch had been dug in a former attempt to drain a portion of the bog. (See Analyses of Soils, marked B, in Appendix to Agricultural Geology.)

The peat varies from 10 to 30 feet in depth, and comprises an area of more than 50 acres. A few holes had been burnt in it, in an attempt to pare and burn the surface.

I advised them to lower the brook 3 feet at the outlet of the swamp, and then to pursue the method of Mr. Phinney in draining and cultivating the bog. This was recommended in 1840, at the commencement of the survey, and since that time the work has been carried on with entire success, as will be seen by the report of William Tripure, which will be found, marked D, in the Appendix to Agricultural Geology.

With the caution so characteristic of the Shakers, small portions of the bog were experimented upon at first, and then more was put under cultivation, and I doubt not the whole will soon be a verdant meadow, or a rich corn field.

Ashes, lime and animal manures were tried, side by side, on separate lots, for comparison.

Ashes did best at first, but subsequently the limed part came up to it, and finally surpassed it in fertility. Animal manures did well, and, on one spot, where the carcase of a cow had been buried, a green spot, for a distance of 10 feet around, was noticed as the result of the ammoniacal gases extricated from the decaying body.

Crops grown on the bog were corn, potatoes, beans, cabbages, carrots, water-melons, all of which did well, excepting the carrots, which, as I had predicted, were short and thick, looking more like tubers than tap-roots. The potatoe not being a root crop, but merely consisting of tuberous enlargements of buried stems of the plant, does admirably on peat land, and is always of good quality on such soil.

The corn crop, (although no animal manures were used,) did well; ashes and lime were put in the hills, and furnished, by their action on the peat, all the manure required; for they render the peat soluble and disengage ammonia from it, while they also combine with the acids that would otherwise injure the roots.

All the experiments made with lime were entirely successful, and if it could be had cheap enough, might be used to bring the whole bog into a fertile state. Leached ashes will answer in its place, if they can be had in sufficient quantities.

I examined the upland soils on the Shaker's farm. (See Analyses of Soils, marked B., in Appendix to Agricultural Geology.) The soil is very poor and rocky, and requires a plentiful supply of peat compost, which is now making, at my suggestion, and, thus far, has proved to be of the best kind. They lay down a large quantity of peat, cover with animal manure, and then put another layer of peat and then of manure, and so form a bed. Then they plough it over thoroughly with a heavy plough, which mixes it well. In the spring they mix in lime, and I advise, that at least, one cask to each wagon load, should be mixed with the manure a fortnight before it is spread. It is to be mixed in with the plough, as before mentioned, and the whole may be then rounded up into a heap, to keep in the gases. The lime should be dry slacked with water, or wet soil, before it is mixed with the compost.

Experiments were also made with salt on turnips grown on a poor piece of gravelly upland. (See Tripure's report.) I measured the diameter of average turnips from the

land that had no salt, and that where it had been spread; the first was one inch in diameter, and the second four inches in diameter.

Oil has also been successfully tried, and has been mixed with soil, ashes, &c., all of which did well, but it costs too much.

Limed peat compost tried against clear stable manure, surpassed it in fertilizing power, and was a more permanent manure. Lime proved to be better in compost than ashes, when put on upland.

These experiments, made with fidelity and care, as they have been, and carefully compared with each other, and with ordinary manures, have completely demonstrated the value of chemical science in agriculture; and it was satisfactory to learn that every experiment gave the result predicted, without a single instance of failure. (See historical sketch of Shakers, marked E., in Appendix to Agricultural Geology.)

Observations on the Farm of Mr. Levi Bartlett of Warner.

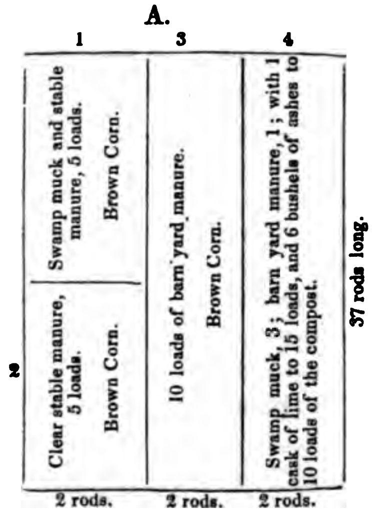
I examined the farm of Mr. Levi Bartlett of Warner with great satisfaction; since that gentleman had conducted his operations in so skillful a manner, that they may be justly called experiments in scientific agriculture, a rank which few experiments, as they are called, can be entitled to, as they are very rarely made with due precautions against error, and are rarely compared properly.

Mr. Bartlett has studied, with care and just discrimination, the various treatises on Agricultural Chemistry, and applies, with sound judgment, the principles of the science to the improvement of the art.

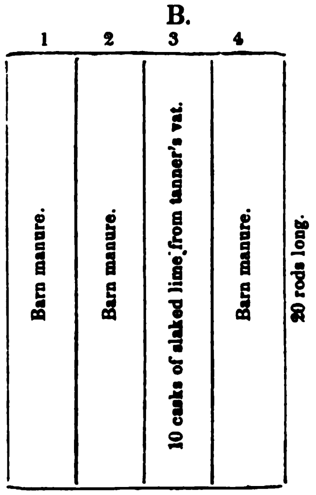
Considering some of his experiments to be excellent models for others, I shall give an example of one of his operations.

A field, having a soil of very uniform nature, was divided off in the manner below represented, for the comparative trial of manures—Diagram A. And another is represented in Diagram B.

A.



B.



In field represented in diagram A., which I visited on the 11th and 12th of August, 1842, the corn crops on No's 1 and 2 did not perceptibly differ, and were both very good.

No. 3 was good, but not equal to 1 and 2.

No. 4 better than No. 3, but not quite equal to No. 2.

This experiment, Mr. Bartlett thinks, has satisfactorily proved that a compost of 3 loads of swamp muck and 1 load stable manure is equal in value to clear stable manure, and better than barn yard manure.

In diagram B., a piece of land is represented, on which the following experiment was made:

In 1837, a piece of land, 1 1-2 rods wide and 20 rods long, was ridged on account of its being cold and wet. It was treated, by mistake respecting the directions, with 10 or 12 casks of slaked lime from the tanner's vat, (hydrate of lime with a little animal matter,) and potatoes were planted. The crop was found to be injured by corrosion, the potatoes being very rough on the surface, (a common effect of over liming.) In 1838, he sowed the same spot with oats; when it was found that the oats did not grow well, where there was so much lime, but did well on its margin. He now laid down the land to grass, and mowed it two years. In 1841, he took it up again, manured it with barn manure, and planted potatoes. The potatoes showed some roughness where there was most lime, but the crop was more abundant in that part than where no lime had been spread.

This spring, (1842,) he sowed the four ridges with oats, and the luxuriance of the crop on the limed land is very remarkable, the oats being much heavier, and, in every respect, superior on that strip; insomuch that the difference may be observed as far as the place can be seen. This experiment, although partly accidental in its nature, was turned to good account by this observing and reflecting agriculturist, who perceived in the action of this soil the principles on which the action of lime depends, and thereby profits from the experiment. Liming, he infers, is highly favorable to the soil; but too much must not be put on at once, or the farmer may have to wait some years for its favorable action, which will ultimately be manifested, and the soil afterwards will continue more fertile; for there must be time for the saturation of the lime with vegetable acids and carbonic acid, before it will do any good.

When lime is to be used in agriculture, I always insist on its being worked into the compost made of peat and swamp muck, and barn yard or stable manure, and that the lime must be first dry slaked, and then mixed into the compost while digging it over in the spring, say a fortnight before spreading it on the soil; and, if any smell is perceived, the heap must be sprinkled over with gypsum, or covered with a thin layer of swamp muck or peat, to absorb the ammoniacal gases. When lime is used alone, for top dressing, it should be spread only on soil that has a considerable proportion of vegetable matter, say as much as 10 per cent.; and on such soil it will prove a fertilizing agent. If the soil is poor and acid, the lime should be first air slaked before it is spread, and manure may be subsequently ploughed or harrowed in; when a manifest reaction will take place, resulting in the formation of good neutralized manures. On reclaimed peat bogs, slaked lime may be spread in any quantity, without danger of too heavy a dressing; for the acids of peat will take it all up very soon.

The rotation of crops on Mr. Bartlett's farm are as follows:

1st. Indian corn and potatoes, cultivated on the inverted sod, which is rolled down and manured, by spreading the compost before described and harrowing it in. Sometimes he ploughs in long manure.

2d. Uses the cultivator and sows with wheat or oats, and lays down to grass, no manure being put on when the wheat is sown.

3d. Keeps the field in grass, and mows so long as it yields a good crop, and is not bound out.

He ploughs in the spring, say from the 6th to 15th of May, according to the season, and turns over the sod and rolls it down, and allows it to remain until entirely decomposed, without disturbance, after the manner recommended by Mr. Phinney of Lexington, Mass.

Notwithstanding the drought of the last two summers, his grass seed has taken well, and heavy crops of grass have been obtained.

Mr. Bartlett has underdrained much of his wet land, either by blind ditches, filled with bushes, or by covered stone drains. During the past two years he has made 150 rods of underdrains, to the manifest improvement of the land.

Subsoil has also been used for a top dressing, with good effects, and is regarded as an excellent method of renewing the soil. From a single year's experience, he thinks he should regard subsoil as of equal value with barn manure. This, of course, depends on the salts and liquid manures which have infiltrated into the subsoil, and the value of it must, therefore, depend on its situation, and on the length of time the surface has been dressed with manures.

Where an old brush fence had been removed, and the land had been tilled and treated with a limed compost, a heavy crop of corn was growing, which probably yielded, at least, 75 bushels to the acre. This soil had been treated with 30 loads of compost, and was twice ploughed and harrowed, and on the 7th of May was planted with corn. The compost consisted of swamp muck, 3 loads; barn manure, 1 load; and to 15 loads, 1 cask of lime and 5 or 6 bushels of ashes were added. The L'Etang lime is preferred as the purest. It costs $1.25 per cask in Boston, or $2.50 in Warner.

I examined a large heap of excellent compost, which Mr. Bartlett has made by mixing a lot of chopped, damaged raw hides with swamp muck. The hides had become a tremulous jelly, and the decomposition was going on well; while there was but little, if any, odor perceptible, the gases being absorbed. The compost is to be mixed with lime, ashes, gypsum and ground bones, and will be extremely rich. Among his recent improvements, is the decomposition of bones and horn piths, by means of the refuse black salts of potash works, the bones being broken into pieces with an axe, and then boiled an hour or two with the salts, until they crumble into powder. The whole mass, both liquid and solid, is to be thrown into a peat compost. This is an excellent method. The refuse liquors of the graining vat of tanners and morocco dressers may also be used economically with peat, for a manure.

I had hoped that Mr. Bartlett would have found time to write for me a full account of his farm; and, for want of a more complete report, I here offer a copy of my field notes, which may serve to give useful hints to farmers, and to prove to them that there are many new ways of making fertilizers, beyond those practised by the ancients.

Observations on the Farm of Mr. David Stiles, Lyndeborough.

The farm of Mr. David Stiles, in the middle of Lyndeborough, was visited and examined with attention, since Mr. Stiles has adopted the modern improvements in reclaiming peat bogs. His bog is ten feet deep, and has been drained and treated as described by Mr.

Phinney, in my Reports on the Surveys of Maine and Rhode Island. His success, although he was at first somewhat discouraged, has induced his neighbors to follow his example. The swamp comprises 12 acres, five of which are reclaimed. It was ditched two feet deep, and the springs from the uplands were cut off by marginal drains.

He ploughed and harrowed it in the fall of 1839—the next spring furrowed it, and planted corn and potatoes, manuring it with a shovel full of manure to the hill. Half a dozen cart loads of gravel were carted on and spread, but he thinks did no good. (This, of course, could not be known without comparison.)

The corn is the small, or Canada variety, and the crop was about 25 bushels to the acre, which was more than the uplands yielded.

The next year he reclaimed and took up 1 1-2 acres more of the bog; planted potatoes, and obtained a good crop; manured in the hill, 12 loads to the acre.

Third year, he planted corn, and took up a new lot of bog and planted it with potatoes. The corn crop was 35 bushels to the acre. The season being dry, the upland crops failed, while the corn from the bog is said to have been the best in the town.

Fourth year, two acres of the bog were planted with corn; two in oats; one and a half in barley; also, in parts, some were planted with peas, wheat and flax.

I observed that his corn was luxuriant; potatoes looked well; oats a little backward; wheat has failed, but the other crops thrive. He laid down part of the bog to grass, clover, herdsgrass and red top, and they are coming in finely.

Mr. Stiles tried one half of a cask of lime, mixed with barn manure, on his bog—thinks it did no good at first, but during the second year does well. He thinks the lime acts unfavorably the first year, and says his corn was yellow and sickly. It is evident that this was in no way attributable to one half a cask of lime, and some other cause must be assigned for the effect. The oats are now growing on the spot where the lime was used last year.

Mr. Stiles' improvements are here stated, not as new information, but as a case where the cultivation of a peat bog in New Hampshire has been turned to good account. Had he followed the directions of Mr. Phinney more closely, he would have been more successful, and would have been less troubled with brakes and wild grasses, which infest the soils, when the small grains are raised where the hoe cannot be used. He should have turned the peat turf over flat, and then have rolled it down hard with a large and heavy roller, and not have cross ploughed and harrowed the bog, which has made much trouble by disturbing the sod, and bringing up the wild grasses and brakes. The sod should not have been disturbed for three years by the plough, but the cultivator should have been used in its place. He should have spread fine loam on the surface, and got in his grass seed as soon as possible, after his potatoe and corn crop. A portion of the peat ought to have been saturated with the liquid manures of his stalls, and would then have made the best manure for the bog.

Remarks on the beneficial effects of Ashes on Peat Bogs.

While in Kingston, I had occasion to visit a small peat bog recently reclaimed by Mr. Magoun, and at the time I was there, crops of Indian corn and of potatoes were growing upon it, and manifested some interesting appearances. I noticed that there were spots

where the corn stalks and potatoe vines were remarkably luxuriant, and of a dark green color, while in other parts of the bog the plants looked yellow and sickly, and in some instances the corn plants were dead. On investigating this, I found that on every green spot the stump of a tree had been burnt, and its ashes had acted as a fertilizer, by neutralizing the acids and by furnishing the requisite earthy and saline matters.

Where earth had been spread on the bog near its margin, the same good effects were manifested. It was evident that there was some corrosive acid substance in the peat, where the plants looked sickly, and on taking the soil from under the sickly and dead plants and analyzing it, I found it to be charged with acid, sulphate of iron and alumina, or copperas and alum, while the peat under the healthy plants was neutral and contained salts of potash and lime. This shows the importance of the chemical analysis of peat; for it here clearly indicates that nothing more than lime, old mortar and leached ashes are required to render such peat at once highly fertile. When there is no great quantity of copperas or alum present, a good subsoil will answer for a top dressing to peat and swamp muck; but it should be remembered that mere *siliceous sand* is not of any use, and it is a waste of labor to cart it on to a bog.

Visit to Farms in Franklin, Shelburne and Whitefield.

FRANKLIN. On visiting the farm of G. W. Nesmith, Esq., of Franklin, I had the pleasure of seeing the use of lime as a manure successfully tried.

He mixes gypsum, 800 lbs.; lime, 2 casks; soil, 2 loads, 3-4 of a cord each. A handful of this mixture is used to each hill of corn. The corn is Brown's variety—the crop 50 bushels to the acre.

He uses a compost of road scraping and barn yard manure; 11 cords, (22 loads,) of this are spread on an acre. Clay is freely used for amendment of the sandy soil with good effect.

He has reclaimed a peat bog and planted it with potatoes, which are doing well.

After liming the upland soil, it produces 25 bushels of wheat to the acre.

Chloride of lime has been used, mixed with a large proportion of alumina and gypsum, by Messrs. Peabody and Daniell. It brings in clover where it was spread on the soil. Oats and corn have grown well on the same land. Some successful experiments have been made, also, with urate of lime, formed by mixing calcined gypsum and urine.

SHELBURNE. Mr. Barker Burbank's farm, on the Androscoggin river, in Shelburne, is remarkably good, possessing the advantages of easy tillage, and yet is sufficiently retentive of manures. The farm is mostly interval soil.

The following is an account of the average yield per acre—grass, 2 tons, on interval; wheat, 20 bushels; oats, 50 bushels; Indian corn, from 40 to 50 bushels; potatoes, 300 bushels.

Wheat crop, this year, (1841,) is injured by weevils, especially the bearded or Black sea wheat, while the Siberian bald wheat is but little affected, and only at the tips of the ears. This is owing to the beard affording shelter to the insects.

Took specimens of this soil for analysis; viz., No. 1, alluvial top soil; No. 2, subsoil five feet from the surface, from the river's bank. (See remarks on the alluvion of this river, in Shelburne, p. 104; also, Analyses of Soils.)

In Whitefield, I visited the farm of Mr. Aaron Garnsey, who has lately tried ashes as a

manure for wheat and oats, and has succeeded in obtaining a very good crop of grain, the wheat amounting to 30 bushels to the acre. No manure was used, but the land was ploughed seven or eight inches deep, and top dressed with twelve bushels of leached ashes to the acre, (rather a small allowance.) His oats were the best in the town, and were very full and heavy. The soil had been summer tilled, and the bushes and sods had been turned in by deep ploughing. The soil is naturally good, like all the uplands in and around Lancaster.

Judge Hayes' Farm, South Berwick, Me.

On visiting the farm of this skillful agriculturist, I was highly gratified to see his excellent improvements in reclaiming peat bogs and making compost manures; also by the perfect cleanness of his culture, no weeds being seen on his tillage land. In reclaiming a bog where there was a thin stratum of peat, closely resembling swamp muck, and not more than a yard deep, Judge Hayes first thoroughly drained the land by surrounding it with ditches and making covered cross drains. He then cut out the hassocks and spread over the surface of the bog a stratum, half an inch thick, of fine yellow subsoil, consisting of a very fine micaceous loam, which he obtains from a bank on the hill side adjoining the bog. Having covered the bog in this manner and spread on a little manure, he sows the bog thickly with herdsgrass, red top and clover. The seed takes well, and the grass soon occupies the entire surface and kills out all the rank and coarse wild grasses. This land has always produced heavy crops of grass, yielding 2 1-2 tons of hay to the acre, and does not suffer from drought.

The most remarkable part of his economical arrangements is the method employed in saving all liquids and solids, that will serve for making compost manure. A drain from the house is made to pass over an inclined plane in the vault, from which every thing is removed by the waste water from the house, and the drain being continued from the bottom of the inclined plane to the back barn yard, the liquid manures are washed along into a heap of swamp muck or peat placed there to absorb them; some clay marl being thrown in, also, on account of the lime which it contains. (Ground plaster would also be a valuable adjunct.) The liquids are thus completely absorbed by the peat, and the barn yard manures are also thrown in with all the liquids from the stalls, and are mixed with the peat. When completely saturated, the compost is removed to the farther end of the yard, and a new lot of peat is placed where it receives the liquids. This process is carried on continually, and a larger supply than is required by the farm is readily made; so that the old compost being free from seeds, produces no weeds when spread on the land. It will be evident that the arrangements, above described, save all the liquid matters that may be converted into manure. All the waste water containing soap is made use of, and every thing that runs off by the drain, goes into the manure heap.

The space behind the barn used as a manure yard, has been dug out from the cliff, from the top of which the peat is dropped from the wagons into the yard. The barn is set up on granite, so that the boards are not rotted by the manure. There are windows in the stalls about level with the floor, which are closed by doors. (See Judge Hayes' letter, marked F, in Appendix to Agricultural Geology.)

APPENDIX,

TO THE GEOLOGICAL PART OF THE REPORT.

Letter of J. L. Hayes, Esq.

Portsmouth, July 8th, 1844.

Dr. Charles T. Jackson:

My dear sir—

At your request, I furnish you with a few notes which I have made, relative to the geology of Portsmouth and its vicinity. I need not refer, of course, to the great features of the geology of this district, for they have already been well observed and clearly and accurately described by you. I can give you a few details, which you may use as you think proper, if you deem them of any value.

The thickly settled parts of the town of Portsmouth lie upon the flinty slate, described in your Annual Report. Frequent dykes of trap have been intruded through the slate. No granite veins are seen in this portion of the town.

The soil which covers the slate and trap, appears to have been formed by the disintegration of these rocks. To this we may attribute the fertile character of the soil of Portsmouth.

I have heard the observation made by practical men, without reference to any geological cause, that the soil immediately covering the rocks which prevail in this vicinity, as in Portsmouth, Kittery and York, is invariably more fertile than that composing the diluvial hills and plains, which prevail a little further in the interior.

In some cases, the hard porphyritic trap may be seen rapidly decomposing. An instance may be observed in Kittery, a few rods from the bridge connecting with this town, where a coarse greenstone trap, containing minute crystals of iron pyrites, is in a state of decomposition. The grasses and common road-side plants grow with luxuriance in the new soil, formed wholly by the disintegrating rock.

At Christian shore, in this town, I have observed a decomposing trap dyke of so fine a texture, that portions falling off may be crumbled between the fingers, like clay.

The surface of the country, in and around this town, has been principally formed by the elevation or depression of the slate and of the trap dykes. There are very few diluvial hills, and the tertiary clays lie quite low. In some cases, ridges, with small valleys intervening, have been made by large dykes of trap, which only here and there appear at the surface. This may be seen on Mr. Freeman's farm, and on the other side of the river, in Kittery.

I have observed trap dykes of only two eruptions in this town. One of the best exposed dykes of trap is in Green street, where it is intersected by the railroad. This dyke is about 14 feet in width, and cuts through the slate. It is coarse in its texture, and is filled with conspicuous crystals of white felspar. The direction of the dyke is northeast. A

small compact dyke, of a brownish black color, has been intruded between the large dyke and the slate.

A trap dyke of a similar structure to the large one just described, forms one of the most remarkable objects on the banks of the river, about a mile above the town. The slate through which it has risen, being easily divided, like that observed by you on Mr. Bartlett's farm, has been broken away, leaving the dyke about four feet in width and fifteen feet high, projecting thirty feet from the bank. The rock, from its singular form and situation, has received the name of the pulpit.

Most of the trap dykes in this vicinity have that imperfectly columnar structure, described by you in your reports, as generally characterizing this rock. A dyke was recently exposed at the Navy Yard, by blasting, which is peculiar in its structure. It is composed of spheroidal nodules of a hard compact trap or basalt. The nodules are nearly globular, and generally about an inch in diameter. They lie closely in contact. The interstitial portions consist of a mere crystaline trap, which easily crumbles when exposed, leaving the hard nodules detached. The appearance of the rock led the workmen who discovered it, to believe it a mass of petrified grapeshot.

A rock strikingly resembling this, has been described by Prof. Rogers, as occurring at the Gorge of the Little Falls in New Jersey.

The structure of this rock is peculiarly interesting, in connection with the celebrated experiment of Gregory Watt, as it proves, conclusively, that the rock must have been once in a melted state. In this experiment, you remember, a large mass of amorphous basalt having been fused and suffered to cool gradually, the cooling mass formed an assemblage of spheroids an inch or two in diameter, precisely similar, as it would seem, to those observed at the Navy Yard.

I have observed in this trap what Watt observed in his experiments, that where two spheroids came in contact, no penetration has ensued, but that the two bodies have been mutually compressed and separated by a well defined plane.

We have here one of the stages in the formation of the hexagonal columns of basalt; for Watt has shown that these columns have been produced by the mutual compression of impenetrable spheroids.

The effects produced by the intrusion of veins of granite and dykes of trap through the flinty slate, are well exhibited at Rye beach, near the dykes described by you as occurring north of Little Boar's Head. These effects are to be observed on a ledge exposed, except during very high tides, about a quarter of a mile from the beach, and connected with the shore by a causeway of loose boulders, the projecting ledge and causeway being the southern boundary of the large beach at Rye.

At the southwestern part of the ledge, the strata of slate, like those above the beach, may be distinctly recognized. At the northeastern extremity the slate passes into a rock, which, from its superior hardness, has resisted the action of the waves, and rises so high as to be generally uncovered. Here you discover that the slate has been broken into fragments of various sizes, from a few inches to two feet in diameter, and cemented into a hard breccia by the action of some protruded melted rock. This rock, which is about twenty feet in width, is bounded on one side by a vein of granite and on the other by a trap dyke. The breccia is a confused mixture of slate, granite and trap.

Among the curious phenomena which may be witnessed at this beach, are the remains of a submerged forest. The stumps and roots of trees of a large size are frequently seen, during very low tides, on the lower margin of the beach. They appear to have been broken off near the roots, which remain in their original positions. The trees were mostly white cedar. Large quantities of the wood have been dug out and dried. The peculiar odor of the wood is as strong as in a recent tree.

My opinion is that these trees do not owe their position to a submergence of the coast, although this is possible, but to the advance of the sea upon the swamps, then covered with trees, which lay contiguous to the sea. These swamps were originally protected

from the sea by the sea wall, which invariably borders a beach. Low wooded swamps are now seen at Rye, separated from the sea in the same manner. The beach at Rye forms the shore of a bog which has evidently been formed by the encroachment of the sea. Stumps of trees are found in most of the salt marshes around Portsmouth, which probably were formerly protected from the sea in the same manner.

Beds of the tertiary clays exist in Portsmouth, as I have found the characteristic fossils near Webird's hill, in strata exposed by digging a well. These clays appear to be but little elevated above the level of the sea.

A brick clay is found at Christian shore, of an excellent quality for bricks and potter's ware, for which it is extensively used. In this clay I have discovered no fossils. Beneath this is a blue clay which cannot be used for bricks, as it will not harden in burning. This probably contains carbonate of lime, and is undoubtedly a tertiary clay.

The drift phenomena exhibited in this region possess much interest.

As in other parts of New England, all the bowlders in the soil around Portsmouth have been transported from the north. I have observed a few rounded bowlders of that well characterized porphyritic granite, containing large square crystals of felspar, which is found in place in the centre of the slate more than fifty miles from this town.

Large bowlders of a peculiarly clouded granite are scattered through Hampton and Seabrook, which have been transported from rocks in place in Deerfield and Northwood, northwest of their present position.

Bowlders of granite from the ledges in Durham, are found in the southern part of Portsmouth. A fine instance may be seen on the farm of John L. Elwyn, Esq. A wall of split stone was partly built by him of granite which occurred in bowlders on his farm. To complete the wall he obtained granite from the quarry in Durham. The rocks from these different localities, now lying side by side, are precisely similar in appearance and structure.

From the observations which I have made, I am satisfied that the surfaces of most of the recently exposed and undecomposed rocks in this vicinity would exhibit well marked drift scratches. I have observed them in several places in different parts of the town.

At Jones' hill, at Christian shore, they occur, cutting across a trap dyke and the edges of the slate. Their direction is N. 20° W., S. 20° E.

They also occur at Mr. Treadwell's farm, on the surface of a trap dyke—direction, N. 20° W., S. 20° E.

They may be seen in the road, near the powder house—direction, N. 15° W.

I have observed them at Kittery, on Mr. Rice's farm.

Muck and peat swamps abound in this vicinity. I have seen some specimens of that curious substance, discovered by you at Limerick, Me., and described in your Report on the Geology of Maine, as a recent bituminous coal. This substance was discovered at New Castle, in a muck swamp. The specimens burn with a clear bright flame, like that from cannel coal. The specimens were found at the time of the speculation excitement, and were exhibited as a proof of the existence of a bed of true bituminous coal. This supposition was considerably nearer the truth than that of some others, who mistook a dyke of trap, in the granite at Kittery Point, for a seam of anthracite coal.

I should be happy to give you a more valuable communication than the above, as some slight acknowledgement for the valuable lessons in geology which you have so kindly given me.

I am, very respectfully and truly,

your friend and servant,

JOHN L. HAYES.

Letter of Eri Pierce.

Winchester, May 15, 1843.

Dr. Jackson—

You will probably recollect when you were at Winchester last fall, I mentioned the existence of certain pot holes in the rocks in the adjoining town of Warwick, Mass. I have since visited them, in company with Jonathan Atherton, Esq., and Mr. Thomas Gould. The day was unfavorable, being cloudy, with some rain; consequently our examination was not very critical. The first we inspected was on the east side of the old turnpike, three feet deep and two and a half across, the south side considerably worn down—the rock is gneiss; line of bearing, north and south; dip, east; angle, from 70° to 80°; large granite bowlders lying about, their angles considerably worn off. To the west, say 100 rods, on land of Joseph Stevens, Esq., and not far from his dwelling house, are several others—one, two and a half feet deep and three feet in diameter; one, two and a half deep and one foot in diameter; one, about a foot broad and four or five feet high on one side—the south side appears to have been broken away. Several smaller ones are near by. All these pots are situated on the southern declivity of a bare ledge of gneiss, forming the dividing ridge between the Ashuelot and Miller's rivers, and are probably two or three hundred feet above the present bed of the Ashuelot river, at Winchester. A valley extends from this ridge southerly to Miller's river, through which flows a small stream. Another small brook passes off northerly, and enters the Ashuelot at Winchester. The land to the east and west rises considerably above the pots, forming a sort of notch through which the water found its way. It appears to have shifted its bed several times during its discharge this way. Here, then, it appears to me, is incontrovertible evidence that this was once the outlet of a lake that flowed over a part of Warwick and Richmond, a large portion of Winchester, Swanzey, Keene and Surry, and a part of Marlborough. A further evidence that the whole valley of the Ashuelot was once a lake, is the fact that sand banks are to be found high up the sides of the hills, showing evident marks of having been deposited by water. These pot holes could not, I think, have been formed by any other agency than running water. It is certain, too, that the rocks have not been raised up since their formation, because, in that case, they would have been thrown out of their present vertical position.

Much more might be said on this subject; but this much is deemed sufficient to convince any candid mind that we are now living at the bottom of a very ancient and very deep lake.

Respectfully yours,
ERI PIERCE.

Barometrical and Thermometrical Observations, made in various parts of New Hampshire, for the measurement of the heights of those places, by C. T. Jackson, M. D.

Date.	Hour.	Place of observation.	Barom.	T.	t.	Remarks.
1840.		Compared Barometers in Portsmouth.				
June 1.	4 P. M.	Station Barometer.	30.43	63		Difference, 0.048
"	"	Mine, Newman's Iron Cistern.	30.382	63		—Stationary Bar-
June 8.	9¾ A. M.	Newington M. H.	30.202	61	61	ometer, or + mine
"	11 A. M.	Piscataqua bridge.	30.330	67	67	
"	2¼ P. M.	Durham M. H.	30.257	71	75	
"	3 P. M.	Cross road on section.	30.308	72	74	
"	5 P. M.	Lee M. H.	30.162	70	71	
"	7 P. M.	Nottingham M. H.	29.866	67	66	
June 9.	10½ A. M.	Saddleback mountain.	29.300	81½	77	
"	12¾ P. M.	Pleasant pond.	29.884	84½	83	
"	3½ P. M.	Suncook river.	30.032	89	88	
"	6½ A. M.	Nottingham M. H.	29.928	62	62	
"	8 A. M.	Round pond.	30.164	72	72	
"	8¾ A. M.	Middle mountain.	29.622	74	72	
"	9¾ A. M.	Lower "	29.610	75	78	
"	11½ A. M.	Upper "	29.500	77	77	
"	1 P. M.	Top of Harvey hill.	30.040	79	77	
"	1¼ P. M.	Foot of "	30.26	82	83	
"	1½ P. M.	Butler's tavern.	29.997	80	76	
June 11.	6¾ A. M.	Concord, State House.	30.050	69	69	
"	1½ P. M.	" "	29.970	77	81	
June 12.	3¾ P. M.	Warner, Walker's tavern.	29.725	89½	85	
"	7 P. M.	Sunapee lake.	29.174	89½	85	
June 20.	8 A. M.	Claremont.	29.200	62	60	
"	11 A. M.	Hill, Acworth.	28.100	62	58	
"	11¾ A. M.	Acworth hotel.	28.264	64	62	
"	12½ P. M.	"	28.200	63	63	
"	6½ P. M.	Claremont.	29.350	60	61	
June 23.	7 A. M.	"	29.770	66	67	
"	9 A. M.	"	29.782	65	65	
"	2 P. M.	Meriden.	29.320	73	72	
"	2¾ P. M.	"	29.300	71	70	
"	5 P. M.	Lebanon.	29.750	79	76	
"	6¼ P. M.	Hanover.	29.790	78	76	
"	10½ P. M.	"	29.751	66	68	
June 24.	7 A. M.	"	29.760	62	64	
"	1 P. M.	"	29.700	76	76	
June 25.	7 A. M.	"	29.650	68	69	
"	3 P. M.	"	29.650	74	75	
"	7½ P. M.	"	29.650	72	72	
June 26.	7 A. M.	"	29.740	62	62	
"	12 M.	Orford hotel.	29.900	74	74	
"	2 P. M.	"	29.880	72	72	
"	11¾ P. M.	Haverhill.	29.650	69	68	
June 27.	10 P. M.	"	29.580	68		

Date.	Hour.	Place of observation.	Barom.	T.	t.	Remarks.
June 28.	7 A. M.	Haverhill.	29.500	68	68	
"	12½ P. M.	"	29.490	78	77	
"	4½ P. M.	"	29.472	79	78	
June 29.	5¼ P. M.	Gannet's, at lime quarry, Hav'll.	28.77	89	87	W.
"	5¼ P. M.	"	28.56	87		W.
"	6.20 P. M.	"	28.532	76		W.
"	6½ P. M.	"	28.532	76		W.
"	7 P. M.	"	28.536	76		W.
"	7.10 P. M.	"	28.540	75		W.
"	7 P. M.	Sugar Loaf mountain, Haverhill.	27.35	75	73	
"	9 P. M.	Gannet's, at lime quarry, "	28.79	69	69	
"	9 P. M.	"	28.57	69		W.
July 1.	8½ A. M.	Haverhill.	29.45	66	67	
"	12¼ P. M.	Watershed line between Haverhill and Warren.	28.62	69	64	
	1 P. M.	J. H. Davis', Warren.	28.80	69	69	
"	1½ P. M.	" "	28.80	68	68	
"	2½ P. M.	Copper mine, "	28.50	66	64	
"	4 P. M.	" "	28.524	64½	64	
"	4.35 P. M.	Brook near copper mine, Warren.	28.662	63	63	
"	4¾ P. M.	Copper mine, Warren.	28.519	62	60	
"	7 P. M.	Wentworth, hotel.	29.510	64	64	
July 2.	6.20 A. M.	"	29.610	59	68	
"	10 A. M.	West Plymouth.	29.8	64	66	
"	12¼ P. M.	New Found lake.	29.72	70	70	
"	3 P. M.	Bristol, tavern.	29.850	71	71	
"	3¼ P. M.	"	29.860	72	72	
"	8½ P. M.	Boscawen, tavern.	30.00	65	67	
July 3.	7 A. M.	Concord.	30.080	62	63	
July 9.	9 A. M.	Gass' hotel, Concord.	29.772	72	73	
"	11 A. M.	" "	29.760	74	74	
July 10.	8 A. M.	Concord.	29.77	74	74	
"	12¼ P. M.	Henniker.	29.66	77	76½	
"	2 P. M.	"	29.67	78	78	
"	6½ P. M.	Francestown.	29.31	75	72	
July 11.	9 A. M.	"	29.416	70	70	
"	12 M.	Mr. Fuller's, Francestown.	29.55	87	84	
"	1 P. M.	" "	29.50	79	78	
"	5¼ P. M.	Mont Vernon.	29.41	86	83	
"	7½ P. M.	Amherst.	29.95	84	83	
July 12.	8½ A. M.	"	30.03	71	71	
"	12 M.	"	30.012	76	76	
"	2 P. M.	"	30.012	76	76	
"	7 P. M.	"	30.00	80		
July 13.	2¾ P. M.	Peterborough.	29.286	80	79	
"	9¾ P. M.	"	29.180	74	74	
July 14.	8 A. M.	"	29.15	70	78	
"	9½ A. M.	"	29.136	80	81	
"	11½ A. M.	Jaffrey hotel, Jaffrey.	28.750	78	76	
"	12 M.	" "	28.75	80	80	

Date.	Hour.	Place of observation.	Barom.	T.	t.	Remarks.
July 14.	12¾ P. M.	Jaffrey hotel, Jaffrey.	28.75	79	79	
"	2 P. M.	" "	28.754	79	80	
"	5 P. M.	" "	28.82	84	84	
"	9½ P. M.	" "	28.85	70	70	
July 15.	6 A. M.	" "	28.95	70	70	
"	7 A. M.	" "	28.952	71	72	
"	8 A. M.	John Felt's house, Monadnoc Mt.	28.800	74	73	
"	8¼ A. M.	Elias Mann's house. "	28.664	72	72	
"	8½ A. M.	" " "	28.664	72	72	
"	9½ A. M.	Mountain side.	27.890	80	81	
"	11 A. M.	Summit.	27.144	77	74	
"	11.10 A.M.	"	27.110	73	69	
"	12 M.	"	27.112	75	70	
"	1.20 P. M.	"	27.120	75	72	
"	3½ P. M.	Base.	28.726	88	88	
"	4 P. M.	"	28.73	87	86	
"	8 P. M.	Keene.	29.66	83	82	
July 16.	10 A. M.	"	29.80	75	80	
"	10½ A. M.	"	29.80	76	82	
"	2 P. M.	"	29.734	77	78	
July 17.	12 M.	"	29.734	84	84	
"	2¾ P. M.	"	29.7	87	87	
"	5½ P. M.	Spofford's pond.	29.45	88	88	
"	6 P. M.	Chesterfield.	29.318	88	88	
July 18.	11½ A. M.	Brattleborough.	29.95	81	81	
"	2 P. M.	"	29.97	82	82	
July 19.	12 M.	"	29.70	80	80	
"	4 P. M.	"	29.686	82	80	
July 20.	7 A. M.	"	29.926	67	68	
"	12 M.	South line of N. H.	29.97	72	71	
"	1 P. M.	Northfield, Mass.	29.91	72	70	
"	2½ P. M.	"	29.90	71	70	
"	4½ P. M.	"	29.90	72	72	
"	5¾ P. M.	Long hill road, summit.	29.35	75	70	
"	6 P. M.	Ashuelot river, Winchester.	29.80	72	70	
"	8 P. M.	Brattleborough, Vt.	29.94	67	66	
July 21.	7 A. M.	"	29.92	63	64	
July 22.	7 A. M.	"	30.10	62	62	
"	1¼ P. M.	"	29.8	74	74	
"	2 P. M.	Level of Connecticut river.	30.15	80	83	
"	5 P. M.	Chesterfield.	29.484	84	82	
"	5¼ P. M.	"	29.484	81	79	
"	7¼ P. M.	Westmoreland.	29.920	78	76	
"	6 P. M.	20 feet above Spofford's pond.	29.60	80	80	
July 23.	7 A. M.	Westmoreland.	29.916	70	70	
"	10 A. M.	"	29.800	73	73	
"	6¼ P. M.	Mr. Lincoln's, Westmoreland.	29.24	70	71	
"	7½ P. M.	" "	29.10	68	68	
July 24.	6½ P. M.	Westmoreland.	29.48	71	71	
"	8 P. M.	Walpole.	29.65	69	68	

Date.	Hour.	Place of observation.	Barom.	T.	t.	Remarks.
July 25.	6½ A. M.	Walpole.	29.86	68	67	
"	10 A. M.	M. H., hill base.	29.86	70	70	
"	10¾ A. M.	" "	29.61	73	71	
"	6½ P. M.	Bellows Falls.	30.03	77	77	
July 26.	8 A. M.	"	30.07	67	70	
"	12 M.	"	30.08	78		
July 27.	8 A. M.	"	30.150	74	74	
"	12 M.	"	31.150	87	87	
"	7 P. M.	"	30.08	80	80	
July 28.	7 A. M.	"	30.00	72	73	
"	9 A. M.	"	29.958	77	77	
"	5 P. M.	10 ft. below summit of Fall Mt.	29.002	83	82	
"	5¼ P. M.	Foot of S., green tree.	29.140	80	78	
"	7.20 P. M.	Slack water below falls.	29.846	77	77	
"	7.25 P. M.	Hotel.	29.740	77	77	
July 29.	10½ A. M.	Bellows Falls.	29.60	77	78	
"	12¾ P. M.	Alstead.	29.560	81	80	
"	2½ P. M.	"	29.574	78	79	
"	4½ P. M.	Warren's pond.	28.874	79	79	
July 30.	12 M.	Keene.	29.78	80	80	
"	5½ P. M.	"	29.80	77	77	
Aug. 4.	8 A. M.	Brattleborough, 2d story Chase's tavern.	29.800	75	75	
"	9 A. M.	5 feet above river level.	29.896	76	76	
"	10¾ A. M.	Chesterfield, tavern, ground.	29.214	77	78	
"	11½ A. M.	5 ft. above Spofford's pond level.	29.344	79	79	
"	2 P. M.	Keene, level of ground, Cheshire house.	29.530	83	82	
Aug. 5.	7 A. M.	Keene.	29.500	74	74	
"	8.20 A. M.	"	29.500	72	71	
"	10 A. M.	Hill road to Gilsum.	28.800	71	71	
"	11½ A. M.	Ashuelot hotel.	29.090	75	76	
"	12 M.	"		75	75	
"	1¼ P. M.	"	29.800	76	75	
"	10 P. M.	Acworth, hotel.	28.500	72	69	
"	4½ P. M.	Alstead, meeting house.	28.690	77	76	
Aug. 6.	6½ A. M.	Acworth, hotel.	28.46	66	67	
"	7¾ A. M.	"	28.44	62	63	
"	10¼ A. M.	"	28.436	67	66	
"	2 P. M.	E. Bailey's.	28.234	71½	71	
"	7 P. M.	Claremont.	29.300	72	72	
"	9 A. M.	"	29.350	66	66	
Aug. 7.	5½ P. M.	"	29.374	68	68	
Aug. 8.	8¾ A. M.	"	29.45	62	62	
"	9¾ A. M.	"	29.45	64	64	
"	12½ P. M.	Plainfield, hotel.	28.98	73	72	
"	2¼ P. M.	"		77	77	
"	3½ P. M.	La Fayette hotel, Lebanon, near meeting house.	29.386	71	76	
"	4½ P. M.	Hanover.	29.450	74	72	

Date.	Hour.	Place of observation.	Barom.	T.	t.	Remarks.
Aug. 9.	10 A. M.	Hanover.	29.666	64	65	
Aug. 10.	8 A. M.	Hanover, hotel.	29.804	61	60	
"	1½ P. M.	Lyme, Perkins' tavern.	29.834	74	72	
"	3½ P. M.	" "	29.800	74	74	
Aug. 11.	7 A. M.	Haverhill, tavern.	29.65	59	60	
Aug. 12.	7 A. M.	"	29.50	66	66	
"	9½ A. M.	"	29.48	72	72	
"	5 P. M.	Bath village.	29.55	77	75	
"	2 P. M.	Haverhill common.	29.45	75	76	
"	3½ P. M.	Horse meadows.	29.614	80	78	Thunder squall.
Aug. 13.	7 A. M.	Bath, hotel.	29.516	69	69	
"	6 P. M.	Franconia.	29.062	72	72	
Aug. 14.	8½ P. M.	"	29.5	69	69	
Aug. 15.	8¾ A. M.	Franconia, hotel.	29.250	69	69	
"	9½ A. M.	Iron mine.	28.578	65	64	
"	1 P. M.	"	28.570	64	60	
"	1½ P. M.	"	28.622	66	66	
"	2¾ P. M.	Franconia, hotel.	29.320	72	71	
"	7½ P. M.	"	29.356	66	65	
Aug. 16.	7 A. M.	"	29.50	53	56	
"	7.20 A. M.	"	29.520	54	56	
"	8.40 A. M.	Height of land.	28.202	61	64	W.
"	9.10 A. M.	Fifield's tavern.	28.251	63		W.
"	10.10 A.M.	⅓ way up Mt. La Fayette.	27.071	60		W.
"	11.5 A. M.	Rock.	26.05	59		W.
"	12.10 P.M.	Summit.	25.054	56	50	W.
"	1.40 P. M.	"	25.054	56	50	
"	2½ P. M.	Rock.	26.069	63		
"	3 P. M.	⅓ way up.	27.064	62	58	
"	4.20 P. M.	Fifield's.	28.270	67	68	
"	4.40 P. M.	"	28.260	66	67	
"	5½ P. M.	Franconia, hotel.	29.306	71	66½	
"	5¾ P. M.	"	29.544	71	71	
Aug. 17.	7½ A. M.	"	29.60	54	56	
Aug. 18.	2¾ P. M.	"	29.7	70	70	
Aug. 19.	9 A. M.	"	29.464	68	69	
Aug. 20.	9 A. M.	Fabyan's hotel, White Mts.	28.684	69	72	
"	10½ A. M.	Notch house.	28.380	75½	75½	
"	3 P. M.	"	28.400			
"	6½ P. M.	"	28.364	74	74	
Aug. 21.	6.40 A. M.	Crawford's house.	28.324	56	56	
"	8.24 A. M.	Mt. Clinton, swamp.	26.250	65	69	
"	9.23 A. M.	Mt. Pleasant.	25.760	71	70	
"	10 A. M.	Mt. Franklin.	25.632	73	68	
"	11½ A. M.	Summit of Mt. Washington.	24.364	68	62	
"	12.10 P.M.	" "	24.350	66	62	
"	1 P. M.	" "	24.350	65	63	
"	3.5 P. M.	Mt. Franklin.	25.400	79		W.
"	3½ P. M.	Mt. Pleasant.	25.475	79		W.
"	4½ P. M.	Mt. Clinton, swamp.	25.940	77		W.

Date.	Hour.	Place of observation.	Barom.	T.	t.	Remarks.
Aug. 21.	5¾ P. M.	Crawford's Notch house.	28.100	77		W.
"	2 P. M.	Summit of Mt. Washington.	24.350	64½	62	
"	3 P. M.	" "	24.310	64	62	
"	4 P. M.	" "	24.310	64	62	
"	5 P. M.	" "	24.310	60	59	
Aug. 22.	8 A. M.	" "	24.252	57	55	
"	9 A. M.	" "	24.252	60	57	
"	10 A. M.	" "	24.301	62½	59	
"	11 A. M.	" "	24.281	61	58	
"	12 M.	" "	24.280	64	62	
"	1 P. M.	" "	24.252	66	62	
"	2 P. M.	" "	24.252	65	63	
"	5 P. M.	Base, at Crawford's.	28.236	78½	84	
Aug. 24.	10 A. M.	T. Crawford's.	28.076	67	68	
"	5 P. M.	Abel Crawford's.	29.016	77	75	
"	8 P. M.	Bartlett, Pendexter's house.	29.470	69	69	
Aug. 25.	7 A. M.	" "	29.550	67	68	
"	10 A. M.	Fryburg, Me., Knight's house.	29.700	69	69	
"	12½ P. M.	" "	29.734	84	84	
"	1 P. M.	" "	29.692			
Aug. 26.	7½ A. M.	" "	29.844	62	64	
"	8¾ A. M.	" "	29.850	67	68	
"	11 A. M.	Conway, Chatoque Corner.	29.826	73	73	
"	12½ P. M.	Eaton, Atkins' hotel.	29.700	76	74	
"	6½ P. M.	" "	29.674	73	72	
Sept. 3.	8½ P. M.	Rochester.	29.890	59	59	
Sept. 15.	3 P. M.	Concord, Gass' hotel.	30.070	74		
Sept. 16.	8¾ A. M.	" "	30.316	58		
"	6 P. M.	Meredith Bridge.	29.950	72		
Sept. 17.	9 A. M.	Gilford, tavern.	30.000	60	64	
"	10½ A. M.	Elkins' barn, at base.	29.500	67		
"	11.10 A.M.	1st iron mine.	28.720	72		
"	11¾ A. M.	Summit of Gunstock mountain.	28.236	66		
1841.						
July 1.	8 P. M.	Nashua, Indian Head, chamber.	30.04	72	72	N.
July 2.	7 A. M.	" " "	29.90	76	77	B.
July 3.	8 A. M.	" " ground.	30.10	61	61	N.
"	8 A. M.	" " "	29.96	59½	61	B.
"	8 A. M.	" " "	30.14	65	70	N.
"	8 A. M.	" " "	29.972	62	64	B.
"	2 P. M.	Hampstead, hotel.	29.86	71	70	B.
"	10 P. M.	R. H., Portsmouth, 2d story.	30.234	61	64	N.
"	10 P. M.	" " "	30.080	63	65	B.
July 4.	7 A. M.	" " chamber.	30.234	69	69	N.
"	7 A. M.	" " "	30.080	69	69	B.
July 14.	1 P. M.	Rochester, hotel, Meserve's.	29.874	83	84	Fair.
July 15.	7 A. M.	" "	29.850	72	74	"
"	9 A. M.	Milton, 3 Pond Post Office.	29.592	78	80	"
"	2 P. M.	Wakefield.	29.350	78	83	"
"	2½ P. M.	Ossipee.	29.310	78	82	"

Date.	Hour.	Place of observation.	Barom.	T.	t.	Remarks.
July 15.	4½ P. M.	Ossipee Corner.	29.324	80	84	Fair.
"	7½ P. M.	" Thyng's hotel.	29.550	78	78	"
July 16.	7 A. M.	" Centre.	29.600	68	72	"
"	10 A. M.	Eaton, Atkinson's tavern.	29.480	75	76	"
"	12 M.	Eaton.	29.510	78	80	"
"	3¾ P. M.	" Lead mine.	29.528	75	78	"
		[above.	.530			"
"	3¾ P. M.	Cook's pond, near mine, 3 feet	29.634			"
"	3½ P. M.	At the Lead mine.	29.530	76	78	"
July 17.	8½ A. M.	Atkinson's tavern, Eaton.	29.620	62	62	"
"	10½ A. M.	Eaton, Joshua Nickerson's.	29.412	79	79	"
July 18.	6 P. M.	" Atkinson's tavern.	29.636	78	78	"
July 19.	10.10 A.M.	Tamworth, M. Downes'.	752.75*	26		"
"	12 M.	" "	753.	29½		"
"	1¾ P. M.	Eaton, Atkinson's tavern.	750.8	28		"
"	2½ P. M.	" " "	750.5	28½		"
July 20.	1 P. M.	Conway Corner, Adams' hotel.	761.35	29½		"
"	1½ P. M.	" "	761.35	31		"
July 21.	7 A. M.	" "	761.	21		"
"	7½ A. M.	" "	760.50	21½		"
"	12½ P. M.	Chesley's, Jackson.	751.40	30		"
"		" "	747.25	24		"
July 25.	6½ A. M.	" "	744.	20		Showers of rain.
July 26.	8½ A. M.	Randolph, Mann's hotel.	727.5	21½		Fair.
"	4 P. M.	Cady's, Lancaster.	741.9	20¾		"
July 27.	8 A. M.	" "	743.	17		"
"	9½ A. M.	" 13 feet above ground.	742.4	19		"
"	10½ A. M.	Cady's, Lancaster.	742.3			"
"	2½ P. M.	" 10 feet above ground.	740.3	25½		"
July 28.	7½ A. M.	" " "	739.25	24½		Wind.
"	8¾ A. M.	" " "	738.45	20		"
"	2 P. M.	Cady's Lancaster.	737.45	17½		Fair.
"	3½ P. M.	" "	740.	20		"
July 29.	7 A. M.	" "	742.5	15		"
"	10 A. M.	" "	742.	14½		"
"	2¾ P. M.	" 10 feet above ground.	740.	20		"
July 30.	12 M.	" 15 feet above ground.	740.	25		"
Aug. 4.	7 A. M.	Lancaster, Cady's hotel.	743.7	19		"
"	1½ P. M.	Mann's hotel, Randolph.	730.5	22		492 feet above
"	2½ P. M.	" " "	730.2	26		Lancaster.
"	5¾ P. M.	Shelburne, Green's tav.,ground.	746.7	26½		Fair.
Aug. 5.	7 A. M.	" "	746.19½			"
"	10 A. M.	" 13 ft. above ground.	745.8	22		"
"	12 M.	" " "	745.6	24		"
Aug. 6.	12 M.	" " "	746.	27½		"
"	A. M.	" " "	746.	21		"
Aug. 7.	7½ P. M.	Berlin, Green's tavern, ground.	738.	21¼		"
Aug. 9.	9½ A. M.	Northumberland, H. Hale's tav.	740.7	19½		Slight rain.
"	12 M.	Cady's, 13 feet above ground.	739.4	21		Cloudy.
Aug. 10.	7 A. M.	" " "	744.5	21		Fair.

*The remaining observations in this table were made with a French instrument, and are given in *millimetres* instead of inches, and the temperature according to the centigrade thermometer.

Date.	Hour.	Place of observation.	Barom.	T.	t.	Remarks.
Aug. 10.	3½ P. M.	Stratford, Birch's.	743.	24		Fair.
"	6¼ P. M.	Colebrook, Chamberlain's tav.	740.3	23		"
Aug. 11.	9½ A. M.	" "	740.7	21		"
"	10½ A. M.	Lime pond in Columbia.	730.7	22		Pond 350 ft abv.
"	12 M.	" "	730.5	22		Chamberlain's.
Aug. 12.	10 A. M.	Chamberlain's tavern, ground.	739.	21		Fair.
"	11 A. M.	" "	739.	22		"
"	12 M.	" "	738.7	22½		"
Aug. 13.	8½ A. M.	" "	736.	18		Clouds.
"	9 A. M.	" "	735.7	18½		"
"	11 A. M.	Dixville Notch, road.	712.4	21		835.6 ft. above
"	12½ P. M.	" "	712.6	20		Colebrook tav.
"	2½ P. M.	" "	713.	19		Cloudy.
"	5 P. M.	Chamberlain's tav. Colebrook.	737.5	19		Fair.
Aug. 14.	9½ A. M.	" "	742.	16		"
Aug. 16.	9 A. M.	Cady's tavern, Lancaster.	749.3	17		"
"	1½ P. M.	Concord, Vt.	731.	26		"
"	5¾ P. M.	St. Johnsbury.	751.	26		"
Aug. 17.	11½ A. M.	Cabot, tavern.	740.	26¼		"
"	5½ P. M.	Montpelier, hotel, 14 ft. ab. gr.	752.25	30		"
Aug. 18.	6½ A. M.	" "	751.	22½	65	"
"	1 P. M.	Richmond, Harrington's hotel.	756.35	32		"
Aug. 19.	8½ A. M.	Burlington, hotel.	756.45	25½		"
Aug. 25.	9 A. M.	Burlington.	764.	17		"
"	1 P. M.	Charlotte.	764.	21½		"
Aug. 26.	9 A. M.	Middlebury.	757.61	21		"
"	1 P. M.	Smith's tavern, Green Mt. road.	739.5	26		"
Aug. 27.	6½ P. M.	Strafford.	743.	19		"
Sept. 2.	9.20 A. M.	Haverhill.	746.5	16½		"
"	2 P. M.	Littleton.	739.8	20		" [P. M.
Sept. 4.	10 A. M.	"	735.2	23½		" Thunder
Sept. 7.	7½ A. M.	Benton.	735.	23		"
Sept. 9.	7 P. M.	Orford.	758.6	23¾		"
Sept. 10.	10 A. M.	"	758.	17½		"
"	10½ A. M.	Lime quarry, Orford.	720.3	23		"
Sept. 11.	10 A. M.	Orford, hotel.	754.	20		"
"	12½ P. M.	Mr. Martin's.	735.½	25		"
Sept. 13.	12 M.	Lyme tavern, West village.	753.5	20		"
Sept. 14.	4½ P. M.	Canaan, tavern.	738.51	21½		"
Sept. 15.	8 A. M.	" "	743.	15		"
"	10.10 A.M.	Pot holes.	746.5	17		"
"	10¾ A. M.	"	747.	24¾		"
"	12 M.	Near Canaan line.	729.6	20¾		"
"	6¾ P. M.	Grafton, Baldwin's hotel.	750.	17		"
Sept. 16.	12 M.	Salisbury, tavern.	752.14	19½		"
"	2 P. M.	" "	751.	18½		"
Oct. 2.	9 A. M.	Nelson, Mr. Nimme's.	733.	13		"
"	2.40 P. M.	Nimme's hill.	735.7	14		"
"	8½ P. M.	" Village.	750.	14		"
Oct. 3.	Evening.	Nelson, hotel.	742.			Violent snow st.,
Oct. 4.	9 A. M.	Hancock.	737.½		36	ground covered.

***Barometrical and Thermometrical Observations, made in various parts of New Hampshire for the measurement of the heights of those places,* in 1842, *by* C. T. Jackson, M. D.**

Date.	Hour.	Place of observation.	Weather.	Barometer.		Temp.		Remarks.
				Inch.	milli.	ins.	air	
1842.			[S.W.W.					Height.
July 8.	3 P. M.	Concord, Gass' hot. 2d st.	FairE.w'd		762.	76	76	374 feet.
July 9.	8¾ A. M.	" " "	Clouds, fr.		757.5	75	74	
"	3 P. M.	" " "	Sho'r atM.		757.75	76	76	
"	6 P. M.	" " "	Rain.		759.	72	72	
July 10.	1½ P. M.	" " "	Fair.		765.	70	70	
July 11.	12 M.	Epsom, Lock's tavern.	" S.W.W.		761.½	76	76	443.8 ft. abv.
"	1½ P. M.	" "	" "		762.	73	76	sea at Ports.
"	7½ P. M.	Deerfield.	Fair.		758.	75	75	494ft.abv.sea
July 12.	7 A. M.	Greenfield.	" &w'dy.	29.88	759.7	70	70	418 "
"	10 A. M.	Raymond.		30.145	766.	77	79	269 "
"	12 M.	Epping.		30.200	767.	75	81	132 "
"	1 P. M.	"		30.170	766.½	81	81	
"	6 P. M.	Portsmouth, Rock. house.			764.½	83		
"	6 P. M.	" "	Fair.		763.½	85	83	
"	8 P. M.	" "	"	30.172		83	80½	
July 13.	A. M.	" Brewster's off.	Calm and	30.132		79	80	40 feet.
"	6 P. M.	" "	clear	30.075		83	84	
July 14.	6½ P. M.	Boar's Head, Hampton.	weather.	30.040		84	83	60 to 70 ft.
"	9½ P. M.	" "	Fair.		763.	71	72	
July 15.	7 A. M.	" "	S. E. W.		764.5	72	73	
"	11¾ A. M.	Kingston, tavern.	Fair, cumulus clouds, Light S. W. W.	30.062	764.	81	79	70 feet above
"	5 P. M.	" "		30.060	763.75		81	sea.
July 16.	6¾ A. M.	" "		30.070	764.2	81	72	
"	11 A. M.	" "		30.090	764.52	72	73	
"	2½ P. M.	Derry, "		29.750	756.	74	79	
"	8 P. M.	Manchester, 3d story.		29.900	759.6	79	78	
July 17.	10 A. M.	" Shepherd's.		29.850	758.5	76	78	
July 18.	5 P. M.	Amherst,C. H. Atherton's.		29.822	757.½	85	94	
July 19.	7 A. M.	" "		29.820	757.½	76	76	
"	7 P. M.	" "	Smart	29.780	756.½	63	62	
July 20.	6¼ A. M.	" "	show'r	29.710	754.½	66	69	
July 21.	7 A. M	" "	4 P. M.	30.200	767.2	72	73	
"	9 A. M.	" "		30.220	768.	67	68	
"	1 P. M.	Wilton, Gowing's hotel.		30.125	765.¼	61		
"	9 P. M.	Lyndeborough, hotel.		30.060	756.½		62	
July 22.	7 A. M.	" "	Fair weather, with S. westerly winds, occasionally the air smoky, but no rain.	29.750		61	62	
"	1½ P. M.	Temple, hotel, ground.		29.426	756.			
"	3½ P. M.	" "		29.370	746.	79	79	
"	3½ P. M.	" "		29.270				
"	5 P. M.	" mountain.		28.360				814 ft. above
"	5¼ P. M.	" "		28.495	724.	79	77	Temple,
"	5¼ P. M.	" "		28.340				Hotel village
"	5.20 P. M.	" "		28.470	723.8	74	74	
"	6¼ P. M.	" hotel.		29.310	744.¼	76	76	
"	8 P. M.	NewIpswich,Edw'ds' hot.		29.380	746.½	74	70	
July 23.	7 A. M.	" "		29.380	746.½	70	70	

Date.	Hour.	Place of observation.	Weather.	Barometer.		Temp.		Remarks.
				Inch.	milli.	ins.	air	
July 23.	9 A. M.	N. Ipswh. Edward's hotel.		29.400	747.	74	75	
"	12 M.	Rindge, M. H.		29.050	738.	81	80	
"	1¾ P. M.	Fitzwilliam, hotel.		29.160	740.8	84	82	
"				29.150	740.25	86	82	
"	2 P. M.	" "	Fair.	29.760				
July 24.	12 M.	Keene, Cheshire house.		29.600	756.	77	79	
July 25.	8 A. M.	" "			759.½		68	
July 27.	3½ P. M.	" "		29.62		79	80	
July 28.	9½ A. M.	" "		29.80		70	70	
"	5½ P. M.	Hinsdale.		30.05			78	
Aug. 2.	8 A. M.	Brattleboro', Vt.		30.05			64	
"	2 P. M.	Chesterfield, tavern.		29.50			70	
Aug. 3.	2 P. M.	Keene, ground, Chesh. h.		29.940		68	69	
"	7 P. M.	Peterboro', hotel.		29.640		66	66	
Aug. 4.	9½ A. M.	" "		29.65		65	65	
"	12 M.	" "		29.53		65	65	
"	5 P. M.	Weare.	Hard rain.	29.750		68	68	
Aug. 5.	8½ A. M.	"	Cleared.	29.800		68	68	Thunder
"	6¼ P. M.	Dunbarton.	Rain.	29.77			74	sh'wr over
Aug. 7.	11½ A. M.	Concord, Gass' hotel.	Cloudy.	30.			73	Henniker.
Aug. 9.	10 A. M.	" State House.	Fair.	30.110			74	
Aug. 10.	1¾ P. M.	Warner, Walker's hotel.	"	29.925		79	78	
"	6¼ P. M.	" "	"	29.900		78	76	
Aug. 11.	3 P. M.	" Mr. Bartlett's.	"	29.895		76	77	
Aug. 12.	7 A. M.	" " Walker's.	N. E. wind, light cum. &	29.840		73		
"	7½ A. M.	" "	rain, cl'ds in	29.840		72	70	
"	8¾ A. M.	A. Watkin's, base Mount Kearsarge	hor., mist on mt. top, fair	29.180		72	74	
"	11½ A. M.	Kearsarge Mt. Summit.	at noon, clo'd	27.338		72	65	
"	11¾ A. M.	" "	in N. W. and	27.338		70	65	
"	12.10 P.M.	" "	S.E., shower, N. E. wind.	27.330		73	65	
Aug. 13.	8.35 A. M.	West Mint hill. W'ks. tav.		29.923		70	70	
"	10½ A. M.	" "		28.490		69½	68	
"	12¾ P. M.	" "		29.907		68	67	
Aug. 14.	11 A. M.	Concord, Gass', 2d story.	Hazy.		758.5	70	69	
Aug. 16.	10 A. M.	" "	Fair.		758.5	74	72	
Aug. 17.	1.20 P. M.	Barnstead Parade, tavern.	Cloudy.	29.612		79	80	
Aug. 18.	5.55 A. M.	Wingate's, Strafford.	"	29.300		71	65	
"	7.38 A. M.	Blue mountains, summit.	"	28.706		64	62	
"	8.20 A. M.	Wingate's, Strafford.	"	29.270		67	68	
"	12.50 P.M.	Pittsfield, tavern.	Pleasant.	29.560		77	77	
"	2 P. M.	" "	"	29.541		76	76	
"	4 P. M.	Summit of Catamount.	"	28.691		79	72	
"	4.20 P. M.	" "	"	28.689		77	76	
Aug. 19.	10.48 A.M.	Epsom, Mr. Goss'.	Fair.	29.140		79	78	
"	11½ A. M.	McKoy mountain.	"	28.781		82	80	
"	1 P. M.	Frost mountain.	"	28.622		85	82	
"	2.40 P. M.	Mr. Goss', Epsom.	"	29.085		86	85	

Date.	Hour.	Place of observation.	Weather.	Barometer. Inch.	Barometer. milli.	Temp. ins.	Temp. air	Remarks.
Aug. 23.	9 A. M.	Concord, State House.		30.39		72		
"	9 A. M.	" "		30.31		72		
"	3½ P. M.	" Gass' hotel.		30.30		76		
"	6½ P. M.	Shaker Village.		29.81		74		
"	6¼ P. M.	"	Very fair.	29.82		76		
Aug. 24.	7½ A. M.	"	Calm.	29.80		72		
"	12 M.	"		29.67		70		
Aug. 25.	7 A. M.	"		29.90		77		
"	11 A. M.	Sanbornton Bridge.	Fair.					
"	12 M.	" "	"	29.90		72½		
"	4 P. M.	Franklin, hotel.	Rain.	30.05		77		
"	5½ P. M.	" "	"	30.02		73		
Aug. 26.	7½ A. M.	" "	Foggy, rainy	29.96		70		
"	3½ P. M.	" "	thick weath.	29.90		76		
Aug. 27.	7 A. M.	Andover, Cooke's H.		29.50		72		
Aug. 28.	10 A. M.	Wilmot.		28.53		70		
Aug. 29.	7 A. M.	"		28.49		72		
Aug. 30.	7 A. M.	" Chapman's.		28.77		69½		
"	2½ P. M.	" "		28.80		76		
"	2½ P. M.	" "		28.87		76		
"	8 P. M.	Springfield, Durgin's.		29.04		58		
Aug. 31.	8 A. M.	" "		29.14		60		
"	9¾ A. M.	" "		29.45		64		
"	2½ P. M.	Jos. Hill's, Springfield.		28.62		74		
"	6 P. M.	" "		28.59		66		
Sept. 1.	8 A. M.	Springfield, Durgin's.		29.082		63		
"	11 A. M.	" "		29.072		68		
"	2¾ P. M.	Grafton, Rollins'.		29.20		71		
Sept. 4.	9 P. M.	" Pettes' store.		29.37		70		
Sept. 5.	7 A. M.	" "		29.20		71		
"	9¾ A. M.	" "		29.17		69		
Sept. 6.	7 A. M.	" "		29.38		66		
"	1½ P. M.	" "		29.41		71		
"	2¾ P. M.	Orange well.		29.23		65		
"	3 P. M.	"		29.22		64		
"	6½ P. M.	Bomey's, Grafton.		28.80		64		
Sept. 7.	9 A. M.	" "		28.75		63		
"	9½ A. M.	" "		28.80		62		
"	10½ A. M.	J. Kenney's, base Ora. Mt.		28.42		64		
"	11¾ A. M.	Top, "		26.97		56		
"	12 M.	" "		26.98		54		
"	12½ P. M.	" "		26.96		53		
"	2½ P. M.	Base, Kinney's, "		28.37		69		
"	5 P. M.	Grafton, Pettes'.		29.20		69½		
Sept. 8.	8½ A. M.	" "		29.40		70	65	
"	6½ P. M.	Hubbard's, Danbury.		29.30		66		
Sept. 9.	9 A. M.	" "		29.22		69	60	
"	1 P. M.	Andover, Smith's.		29.24		56		
"	3 P. M.	" "		29.20		55		
Sept. 10.	2 P. M.	Concord.		29.97		61		

Date.	Hour.	Place of observation.	Barometer.		Temp.		Remarks.
			Inch.	milli.	ins.	air	
Sept. 14.	5¾ P. M.	Gilmanton, corner.	29.110		63		
			29.215		63		
Sept. 15.	7 A. M.	" "	29.270		64		
Sept. 16.	8 A. M.	" "	29.240		74		
"	2 P. M.	" "	29.190		69		
Sept. 17.	7½ A. M.	" "	29.190		68		
"	3¼ P. M.	Centre Harbor.	29.590		66		
Sept. 18.	8½ A. M.	"	29.55		70	60	
Sept. 19.	1 P. M.	"	29.50		61	60	
"	6¼ P. M.	Sandwich, N. McCrillis' house.	29.12		56		
"			29.09			51	
Sept. 20.	8.10 A. M.	Whiteface Mt., base.	29.21		59		Mt. Whiteface,
"			26.152		54		2941 feet above
"	12.20 P.M.	" summit.	26.021		53	48	McCrillis' house.
"			26.140			48	
"	12.30 P.M.	" "	26.030			45	
"			26.115		47		
"	2 P. M.	" "	26.000		47	44	
"			26.120		49		
"	3.20 P. M.	" "	26.000		49	49	
"			29.130		56		
"	6.20 P. M.	" "	29.025		56		
Sept. 21.	12 M.	" "	28.800		53		
Sept. 22.	8 A. M.	" "	28.760		60		
Sept. 23.	8½ A. M.	" "	28.950		60		
"	2 P. M.	Eaton, Atkinson's.	29.510		59	45	
"	6 P. M.	Bartlett, Pendexter's.	29.600		40	37½	Nearly level of
"			29.70				Chocorua Mt.
Sept. 24.	8.20 A. M.	"	29.70		46	48	Pequaquet Mt.,
"	9 A. M.	"	29.53		46	47	2680½ feet above
"	12 M.	Summit Pequaquet.	26.735	750.25	45	47	Pendexter's store,
"	12½ P. M.	" "	26.710		45	43	3358.8 above sea.
"	1 P. M.	" "	26.715		43		
"	4½ P. M.	Bartlett, Pendexter's	29.57		52	49	
Sept. 25.	12 M.	Jackson, Chesley's.	29.60	751.1	66	49	Eastman's tin
Sept. 26.	9 A. M.	" "	29.59		64		mine, 691.8 feet
"	10¾ A. M.	Eastman's tin mine, lower vein.	28.87		67		above Chesley's—
"	6 P. M.	About 15 ft. below top of Mt.	28.769		58		top of hill about 80
Sept. 29.	6½ P. M.	Mt. Crawford, A. Crawford's hs.	29.26		58		feet above river at
Sept. 30.	7¾ A. M.	" "	29.22		57	54	Chesley's.
"	8¾ A. M.	" "	29.20		51		
"	9¾ A. M.	" "	29.06	738.55	53	53	
"	11½ A. M.	Summit of Mt. Crawford.	26.84		44		
"	11.40 A.M.	" "	26.83		43		
"	11¾ A. M.	" "	26.81		42		
"	2 P. M.	" "	28 98	736.35	52		
"	11½ A. M.	Base "	29.07		54		
"	12 M.	" "	29.06		53		
"	1 P. M.	" "	29.13		57		
"	2 P. M.	On return.	29.13		56		

Date.	Hour.	Place of observation.	Barometer. Inch.	Barometer. milli.	Temp in.	Temp air	Remarks.
Sept. 30.	3¼ P. M.	Return to Crawford's.	28.961		52		
"	3½ P. M.	" "	29.100		55		
"		Fabyan's house.	28.491		51		
Oct. 1.	8½ A. M.	"	28.46		49		
Oct. 3.	8¼ A. M.	Littleton. "	29.10		59		
Oct. 5.	1.20 P. M.	Cady's hotel, Lancaster.	29.545		50		
Oct. 6.	1½ P. M.	" "	29.55		53	53	
Oct. 7.	9¼ A. M.	Littleton.	29.24		52		
"	2 P. M.	Morse's hotel.	29.595		65		
"	5¾ P. M.	Horse meadow, T.	29.380		59		
Oct. 9.		Haverhill.	29.42		62		
Oct. 10.	1½ P. M.	Lyman Plain.	29.57		56		
"	2 P. M.	"	29.56		56		
"	5½ P. M.	"	29.530		56	54	
Oct. 11.	9 A. M.	"	29.450		54	50	
"	4 P. M.	Top Lyman mountain, Bath.	28.322		64	62	
Oct. 12.	9 A. M.	H. Lang's house, "	28.74		51		
Oct. 21.	12 M.	Charlestown, hotel.	29.94		46		
Oct. 24.	7½ A. M.	" "	29.9		54		
"	12 M.	" "	29.87		56		
Oct. 26.	5 P. M.	Unity, J. Neal's house.	29.31		51		
Oct. 29.	3.20 P. M.	S. Johnson's, Cornish.	29.40		58		
"	10¾ A. M.	Base Ascutney Mt. Windsor.	30.14		48		
"	2 P. M.	Summit of mountain.	27.11		40		
"	2½ P. M.	" "	27.10		39		
"	5.40 P. M.	Base, "	30.072		42	55	
"	2½ P. M.	" "	30.16		46		
"	3 P. M.	" "	30.14		46		
"	3.20 P. M.	" "	30.14		47	46	
"	4.10 P. M.	" "	30.14		46	46	
"	6¼ P. M.	Return to Windsor.	30.06		38	38	

Barometrical Register kept at Portsmouth, by C. W. Brewster, Esq.—38.01 *feet above high water mark.*

Date.	10 A. M.		2 P. M.		6 P. M.		Weather.
1840.	Barom	T.	Barom	T.	Barom	T.	
June 8.	30.34	68	30.30	68	30.30	69	Cloudy.
June 9.	30.44	67	30.42	70	30.41	69	Clear.
June 10.	30.41	70	30.34	74	30.32	74	"
June 11.	30.27	72	30.17	77	30.10	77	"
June 12.	30.00	74	29.96	77	29.94	77	"
June 13.	29.86	74	29.85	73	29.96	73	Rain and cloudy.
June 15.	30.03	66	30.02	68	30.01	68	Cloudy, afternoon clear.
June 16.	30.13	66	30.13	68	30.14	69	Clear.
June 17.	30.26	67	30.26	68	30.26	68	"
June 18.	30.25	69	30.19	70	30.14	70	Cloudy.
June 19.	29.82	70	29.75	70	29.73	71	Rain.
June 20.	29.63	67	29.73	67	29.77	68	Clear.
June 22.	29.95	71	29.95	73	30.03	73	Cloudy in the forenoon, with showers.
June 23.	30.30	72	30.29	73	30.29	73	Fair.
June 24.	30.24	73	30.15	77	30.09	80	"
June 25.	30.12	75	30.15	75	30.15	74	"
June 26.	30.30	72	30.30	73	30.30	72	"
June 27.	30.33	70	30.29	70	30.25	70	Rain.
June 29.	30.09	73	30.05	76	30.00	80	Fair.
June 30.	30.05	77	30.02	79	29.98	78	"
July 1.	30.30	76	30.02	77	30.05	77	"
July 2.	30.25	73	30.24	73	30.24	73	"
July 3.	30.40	72	30.39	72	30.29	72	"
July 4.	30.37	70					"
July 6.	30.50	72	30.51	73	30.51	73	"
July 7.	30.44	71	30.43	71	30.40	71	"
July 8.	30.34	75	29.95	75	29.90	77	Cloudy.
July 9.	30.00	75	30.95	77	29.90	77	Fair.
July 10.	29.93	75	29.99	75	30.04	76	"
July 11.	30.25	73	30.20	74	30.15	75	"
July 13.	30.13	73	30.02	75	29.93	75	"
July 14.	29.84	79	29.79	80	29.85	80	"
July 15.	30.06	79	30.07	80	30.09	81	"
July 16.	30.24	81	30.23	82	30.18	82	"
July 17.	30.21	83	30.14	86	30.14	87	"
July 18.	30.22	81	30.22	81	30.21	80	Cloudy.
July 20.	30.15	73	30.14	73	30.15	74	Fair.
July 21.	30.17	73	30.17	73	30.17	74	"
July 22.	30.34	73	30.34	75	30.33	75	"
July 23.	30.30	76	30.24	77	30.22	77	"
July 24.	30.00	73	29.88	73	29.87	72	Rain.
July 25.	30.24	72	30.25	75	30.27	74	Fair.
July 27.	30.44	75	30.43	76	30.42	74	"
July 28.	30.30	74	30.20	76	30.10	75	"
July 29.	29.95	77	29.97	79	30.00	78	"
July 30.	30.25	75	30.25	77	30.25	77	"
July 31.	30.35	76	30.33	78	30.33	76	"

Date.	10 A. M.		2 P. M.		6 P. M.		Weather.
1840.	Barom	T.	Barom	T.	Barom.	T	
Aug. 1.	30.23	75	30.23	74	30.22	73	Rain.
Aug. 3.	30.15	76	30.08	77	30.04	76	Fair, showers.
Aug. 4.	30.03	77	29.99	79	29.95	80	"
Aug. 5.	29.92	76	29.90	78	29.90	77	"
Aug. 6.	29.95	75	29.87	77	29.83	75	Showers.
Aug. 7.	29.89	73	29.88	73	29.94	73	Fair.
Aug. 8.	29.99	73	29.99	73	29.99	72	"
Aug. 10.	30.32	71	30.32	73	30.32	72	"
Aug. 11.	30.32	72	30.24	73	30.24	72	"
Aug. 12.	30.05	76	30.12	76	30.10	75	"
Aug. 13.	30.05	76	30.04	75	30.05	75	"
Aug. 14.	29.85	72	29.85	73	29.85	75	Rain.
Aug. 15.	30.16	72	30.16	74	30.18	74	
Aug. 17.	30.55	70	30.56	72	30.56	71	Fair.
Aug. 18.	30.56	71	30.56	71			"
Aug. 19.	30.39	73			30.25	75	"
Aug. 20.	30.23	76	30.23	78	30 23	76	"
Aug. 21.	30.22	74	30.22	77	30.22	74	"
Aug. 22.	30.20	76	30.15	80	30.15	80	"
Aug. 24.	29.94	77	29.96	78	30.00	77	"
Aug. 25.	30.12	75	30.11	75	30.14	73	"
Aug. 26.	30.15	72	30.17	74	30.17	72	"
Aug. 27.	30.33	74	33.30	75	30.31	73	"
Aug. 28.	30.39	73	30.38	75	30.37	74	"
Aug. 29.	30.43	73	30.43	75	30.48	73	"
Aug. 31.	30.10	73	30.04	77	30.04	75	
Sept. 1.	30.14	72	30.08	73	30.08	72	
Sept. 2.			30.01	72	29.96	71	
Sept. 3.	29.98	70	29.98	70			
Sept. 4.	30.33	68	30.32	70	30.33	68	
Sept. 5.	30.33	66	30.25	66	30.23	66	
Sept. 7.	30.30	67	30.34	71	30.34	71	
Sept. 8.	30.28	70	30.23	72	30.18	72	
Sept. 9.	30.12	73	30.08	74	30.05	74	
Sept. 10.	29.97	74	29.93	74	29.91	73	
Sept. 11.	29.94	70	29.95	71	30.02	69	
Sept. 12.			30.25	66	30.27	66	
Sept. 14.	30.38	64	30.28	64	30.24	63	
Sept. 15.	30.17	63	30.14	65	30.18	65	
Sept. 16.	30.29	63	30.28	69	30.30	62	
Sept. 17.	30.34	65	30.28	69	30.23	68	
Sept. 18.	30.18	68	30.13	69	30.14	69	
Sept. 19.	30.10	68	29.85	68	29.84	67	
Sept. 21.	29.77	63	29.83	64	30.02	62	
Sept. 22.	30.34	59	30.32	60	30.33	60	
Sept. 23.	30.32	62	30.29	62	30.32	62	
Sept. 24.	30.57	62	30.56	66	30.56	64	
Sept. 25.	30.57	62	30.54	66	30.50	64	
Sept. 26.	30.45	64	30.34	67	30.33	66	
Sept. 28.	30.20	63	30.22	66	30.25	64	

Date.	10 A. M.		2 P. M.		6 P. M.	
1840.	Barom	T.	Barom	T.	Barom	T.
Sept. 29.	30.25	64	30.26	65	30.27	65
Sept. 30.	30.27	66	30.24	67	30.24	66
Oct. 1.	30.42	65	30.43	64	30.47	63
Oct. 2.	30.43	62	30.44	63	30.42	63
Oct. 3.	30.14	67	30.08	66		
Oct. 5.	30.22	63	30.21	67	30.18	66
Oct. 6.	30.18	65	30.13	69	30.12	69
Oct. 7.	30.40	69	30.44	69	30.44	68
Oct. 8.	30.54	64	30.46	68	30.42	66
Oct. 9.	30.42	65	30.42	66	30.46	65
Oct. 10.	30.58	64	30.50	66	30.50	66
Oct. 12.	29.58	62	29.64	62	29.78	61
Oct. 13.	30.07	63	30.06	64		
Oct. 14.			29.92	66		
Oct. 15.	30.23	63	30.29	64		
Oct. 16.	30.40	62	30.49	61	30.50	62
Oct. 17.	30.57	61	30.60	63	30.61	61

Mr. Brewster's observations continued.

Date.	Thermometer.			Barometer.			Tem. of Barom.			Wind and weather at noon.
1841.	7 A. M.	1 P. M.	9 P. M.	10 A. M.	2 P. M.	6 P. M.				
June 1.	46	57	53	30.16	30.09	30.04	62	63	63	S. Fair.
June 2.	54	80	60	29.89	29.84	29.84	67	69	70	N. W. Fair.
June 3.	55	65	53	30.03	30.01	30.02	66	67	67	N. Fair.
June 4.	51	76	62	30.08	30.03	30.04	65	67	68	N. Coudy.
June 5.	64	78	53	29.84	29.94	30.04	70	71	70	N. Fair.
June 6.	51	69	57							S. Fair.
June 7.	57	87	75	30.19	30.03	29.98	70	76	79	W. Fair.
June 8.	71	89	57	29.98	29.98	29.98	77	79	77	S. Fair.
June 9.	56	60	56	30.16	30.14	30.14	71	72	69	S. E. Cloudy.
June 10.	60	81	70	30.14	30.06	30.01	70	74	75	N. W. Fair.
June 11.	69	81	69		29.77	29.74		79	79	W. Fair.
June 12.	59	70	59	29.92	29.94	30.70	71	72	70	S. Rain, fair.
June 13.	63	73	61							S. Fair, cl'dy.
June 14.	55	67	61	29.99	29.99	29.97	70	71	70	S. Cloudy.
June 15.	62	75	60	29.94	29.94	29.93	69	70	70	S. Rain, fair.
June 16.	57	73	62	30.06	30.07	30.14	69	70	71	N. Fair.
June 17.	53	72	62	30.28	30.28	30.28	70	69	70	S. Cloudy.
June 18.	60	68	58	30.38	30.38	30.38	69	70	68	E. Cloudy.
June 19.	61	67	56	30.32	30.28	30.24	68	68	66	S. Cloudy.
June 20.	52	68	49							S. Cloudy.
June 21.	49	73	57	30.35	30.37	30.35	65	67	68	S. Fair.
June 22.	56	79	67	30.29	30.26	30.20	69	71	71	S. W. Fair.
June 23.	69	85	64	30.10	30.06	30.02	74	75	77	Fair.
June 24.	64	76	60	30.13	30.15	30.18	74	73	73	S. Cloudy.
June 25.	59	65	60	30.26	30.26	30.26	70	70	70	
June 26.	62	73	65	30.18	30.12	30.05	69	70	71	
June 27.	67	85	75							
June 28.	70	81	72	29.97	29.96	29.96	75	77	76	
June 29.	70	85	77	30.03	30.03	30.03	77	79	78	
June 30.	74	89	70	30.03	30.03	30.00	80	82	80	
July 1.	72	78	69	29.93	29.93	29.93	79	78	77	
July 2.	64	70	57	30.03	30.03	30.12	73	73	71	
July 3.	55	70	54	30.12	30.12	30.10	69	70	70	
July 4.	58	72	62							
July 5.	57	75	64			30.06			70	
July 6.	62	78	68	30.07	30.08	30.03	72	75	75	
July 7.	65	75	67	30.08	30.08	30.05	74	75	74	
July 8.	63	71	62	30.05	30.07	30.08	72	73	73	

Mr. Brewster's observations continued.

Date.	Barometer.				Temp. of Barom.								Weather and Wind.
1841.	10 A. M.	2 P. M.	6 P. M.		T.	t.	T.	t.	T.	t.	T.	t.	
July 9.	30.24	30.22	30.17		71		74		74				W. Fair.
July 10.	29.94	29.94	30.		73		73		73				N.W. "
July 11.													N. "
July 12.	30.02	30.00	30.11		68		70		73				Same.
July 13.	30.18	30.18	30.17		74		73		73				S. Fair.
July 14.	30.25	30.21	30.17		72		74		75				S. Cloudy.
July 15.	30.12	30.11	30.11		76		78		80				N. Fair.
		12 M.	2 P. M.	6 P. M.	10A.M.	10A.M.	12 M.	12 M.	2 P.M.	2 P.M.	6 P.M.	6 P.M.	
July 16.	30.204		30.216	30.260	76	77			77	77	76	75	S.W. Fair.
July 17.	30.44	30.412	30.39	30.358	77	76	74	74	73	73	72	72	N. "
July 18.													S. "
July 19.	30.364	30.36	30.340	30.348	73	73	74	75	75	77	76	76	S. "
July 20.	30.638	30.636	30.622	30.614	75	77	76	77	73	75	76	75	S. "
July 21.	30.600	30.568	30.526	30.464	75	76	77	79	77	77	79	82	S. "
July 22.	30.396	30.372	30.308	30.260	78	79	79	81	82	83	83	83	S.W. "
	9 A. M.	12 M.	2 P. M.	6 P. M.	9 A. M.	9 A. M.							
July 23.	30.404		30.388	30.400	78	79			77	77	76	76	S.E. Cloudy.
July 24.	30.500	30.488	30.452	30.434	73	73	73	73	73	73	73	72	S. "
July 25.													S.W. Fair.
July 26.	30.196	30.200	30.212	30.268	74	73	74	74	74	75	75	74	N. Rain.
July 27.	30.352	30.300	30.238		68	69	71	72	73	74			N. "
July 28.	30.154	30.154		30.250	72	73	72	72			72	71	N.W. Fair.
July 29.	30.352	30.313	30.276		68	68	67	69	69	70			S.W. "
July 30.	30.236	30.234	30.232	30.240	69	70	70	71	71	72	72	72	S. "
July 31.	30.264	30.270	30.266	30.280	68	69	69	69	69	69	69	69	E. Rain.
Aug. 1.	30.250	30.270	30.280	30.330		64		65		65		66	E. "
Aug. 2.	30.464	30.480	30.480	30.484	67	68	69	71	70	71	72	72	S. Fair.
Aug. 3.	30.536	30.500	30.482	30.430	70	71	69	71	75	77	77	77	S. "
Aug. 4.	30.388	30.338	30.300	30.276	75	77	78	79	80	81	82	81	W. "
Aug. 5.	30.298	30.288	30.270	30.246	76	76	76	77	77	77	77	76	S. Cloudy.
Aug. 6.	30.274	30.278	30.276	30.290	75	75	77	76	76	76	77	76	S. "
Aug. 7.	30.342	30.326	30.312	30.304	73	72	74	74	74	74	74	74	N.E. Fair.
Aug. 8.	30.390	30.390	30.390	30.360		68		71		73		72	S. "
Aug. 9.	30.358	30.312	30.312	30.280	73	73	73	73	73	73	73	74	E. Rain.
Aug. 10.	30.406	30.404	30.404	30.392	72	72	73	74	74	75	75	75	N. Cloudy.
Aug. 11.	30.418	30.240	30.240	30.376	72	72	72	72	72	72	72	72	E. Rain.
Aug. 12.	30.360	30.306	30.306	30.294	70	71	73	73	74	75	75	75	W. Fair.
Aug. 13.	30.278	30.278	30.278	30.284	74	77	74	74	74	74	74	74	S.E. Cloudy.
Aug. 14.	30.448	30.450	30.458	30.500	70	70	70	70	70	70	70	70	S. Fair.
Aug. 15.	30.635	30.670	30.670	30.630		63		66		66		66	S. "
Aug. 16.	30.626	30.600	30.508	30.476	65	67	68	69	70	71	70	70	S. "
Aug. 17.	30.420	30.376	30.360	30.322	69	70	73	75	76	77	77	77	S. "
Aug. 18.	30.330	30.318	30.310	30.266	77	78	78	79	79	79	79	78	S. "

Date.	Barometer.				Temp. of Barometer.								Weather.
1841.	9 A. M.	12 M.	2 P. M.	6 P. M.	T. 9 A. M.	t. 9 A. M.	T. 12 M.	t. 12 M.	T. 2 P. M.	t. 2 P. M.	T. 6 P. M.	t. 6 P. M.	
Aug. 19.	30.286	30.272	30.250	30.250	74	75	77	79	78	78	78	77	S. Fair.
Aug. 20.	30.364	30.376	30.360	30.350	76	76	77	77	76	75	76	75	S. Cloudy.
Aug. 21.	30.340	30.330	30.314	30.276	75	76	76	77	76	77	76	76	S. Fair.
Aug. 22.	30.240	30.270	30.268	30.300		70		70		70		70	S. Rain.
Aug. 23.	30.446	30.440	30.436	30.442	69	69	71	72	72	72	72	71	E. Fair.
Aug. 24.	30.640	30.624	30.618	30.600	69	70	71	72	71	71	71	71	S. E. "
Aug. 25.	30.586	30.564	30.522	30.458	68	68	70	71	71	71	71	71	E. "
Aug. 26.	30.426	30.410	30.388	30.364	68	69	71	72	72	73	72	71	S. "
Aug. 27.	30.414	30.400	30.400	30.416	67	67	70	70	70	70	70	70	S. "
Aug. 28.	30.496	30.500	30.500	30.512	70	70	72	72	72	72	72	72	S. E. "
Aug. 29.	30.574	30.576	30.576	30.550		68		68		68		68	S. E. Rain.
Aug. 30.	30.500	30.458	30.428	30.364	70	70	70	70	70	70	70	70	S. E. "
Aug. 31.	30.270	30.252	30.230	30.212	69	69	69	70	69	69	69	69	N. E. "
Sept. 1.	30.168	30.170	30.174	30.164	66	66	67	67	67	67	68	67	N. Clouds.
Sept. 2.	30.210	30.202	30.174	30.150	66	65	67	68	68	69	69	69	S. W. "
Sept. 3.	30.250	30.218	30.222	30.164	67	68	72	73	73	75	74	74	
Sept. 4.	30.040	29.992	29.950	29.960	72	73	75	76	76	77	74	74	
Sept. 5.	30.100	30.140	30.150	30.180		68		69		69		69	
Sept. 6.	30.370	30.400	30.410	30.424	68	68	68	68	68	69	69	69	
Sept. 7.	30.450	30.450	30.450	30.426	67	68	69	69	70	70	70	69	
Sept. 8.	30.408	30.410	30.400	30.410	66	66	69	70	70	70	70	69	
Sept. 9.	30.432	30.442	30.450	30.458	65	62	63	69	69	69	68	68	
Sept. 10.	30.484	30.450	30.430	30.396	66	66	68	69	69	70	69	63	
Sept. 11.	30.300	30.276	30.274	30.254	67	67	69	70	70	71	71	70	
Sept. 12.	30.340	30.334	30.330	30.330		66		67		67		68	
Sept. 13.	30.382	30.376	30.374	30.362	67	67	68	68	68	67	67	67	
Sept. 14.	30.450	30.430	30.426	30.436	65	65	67	68	68	68	69	69	
Sept. 15.	30.616	30.624	30.614	30.616	65	65	68	69	69	69	68	67	
Sept. 16.	30.670	30.650	30.628	30.600	65	65	66	67	67	68	67	76	
Sept. 17.	30.500	30.472	30.454	30.408	63	63	65	66	66	67	66	65	
Sept. 18.	30.356	30.328	30.318	30.318	64	64	66	66	66	68	68	68	
Sept. 19.	30.486	30.480	30.476	30.470		61		62		63		62	
Sept. 20.	30.460	30.430	30.420	30.418	63	63	65	67	66	67	66	66	
Sept. 21.	30.508	30.492	30.464	30.460	65	65	66	66	66	66	66	66	
Sept. 22.	30.336	30.280	30.252	30.214	63	63	64	65	65	65	65	65	
Sept. 23.	30.196	30.200	30.184	30.206	63	63	64	64	65	65	66	66	
Sept. 24.	30.276	30.272	30.234	30.222	66	66	66	66	67	67	68	68	
Sept. 25.	30.300	29.938	29.840	29.800	68	68	68	69	69	69	69	68	
Sept. 26.	30.040	30.000	29.940	29.980		64		66		67			
Sept. 27.	30.312	30.312	30.308	30.346	64	65	66	66	67	66	67	67	
Sept. 28.	30.350	30.336	30.260	30.210	63	63	65	66	66	67	66	67	
Sept. 29.	30.114	30.096	30.084	30.134	65	66	66	66	67	67	67	67	
Sept. 30.	30.044	30.036	30.038	30.080	62	62	62	62	62	62	63	63	

Mr. Brewster's observations continued.

Date.	Thermometer.			Wind and Weather.		
1841.	6 A. M.	1 P. M.	9 P. M.	6 A. M.	1 P. M.	9 P. M.
Sept. 3.	61	78	69	N. Clear.	S. W. Fair.	Same.
Sept. 4.	69	82	66	S. Cloudy.	S. Rain, $\frac{3}{4}$ inch.	Rain and thunder.
Sept. 5.	61	71	61	N. Rain.	N. Cloudy.	N. W. Fair.
Sept. 6.	59	68	62	W. Cloudy.	N. E. Cloudy.	Cloudy.
Sept. 7.	61	70	58	N. Fair.	S. Fair.	E. Fair.
Sept. 8.	54	67	55	E. Fog.	S. E. Clear.	Clear.
Sept. 9.	51	67	55	"	S. Clear.	
Sept. 10.	57	68	62	"	S. E. Clear.	Cloudy.
Sept. 11.	64	72	64	W. Cloudy.	S. Fair.	Same.
Sept. 12.	64	70	61	N. Cloudy.	Cloudy.	S. E. Fair.
Sept. 13.	61	66	59	N. E. Clear.	N. Cloudy.	Cloudy.
Sept. 14.	55	70	57	N. Clear.	S. Clear.	Clear.
Sept. 15.	57	67	53	Fair.	E. Fair.	E. Clear.
Sept. 16.	49	65	51	N. Fog.	S. E. Fair.	Fair.
Sept. 17.	51	69	58	N. Light clouds.	S. Cloudy.	S. E. Rain.
Sept. 18.	55	71	59	S. W. Clear.	S. Clear.	Clear.
Sept. 19.	55	63	50	N. E. Cloudy.	E. Clear.	E. Clear.
Sept. 20.	47	72	57	N. Light clouds.	S. Fair.	Clear.
Sept. 21.	61	65	55	S. Cloudy.	S. E. Cloudy.	Clear.
Sept. 22.	53	65	56	N. "	E. Light clouds.	Fair.
Sept. 23.	58	71	63	N. "	S. Cloudy.	Cloudy.
Sept. 24.	63	65	64	S. Rain.	S. Cloudy.	S. Rain.
Sept. 25.	67	70	61	S. Rain.	S. Rain, 0.65 inch.	N. W. Fair.
Sept. 26.	57	69	62	W. Clear.	S. W. Clear.	W. High wind.
Sept. 27.	51	65	54	N. W. Clear.	N. W. Clear.	Fair.
Sept. 28.	50	68	64	S. W. Cloudy.	Fair.	Fair.
Sept. 29.	64	70	60	Cloudy.	Rain.	E. Rain, 1.35 inch.
Sept. 30.	48	55	44	N. Cloudy.	N. Cloudy.	N. W. Clear.

Mr. Brewster's observations continued.

Date.	Barometer.				Temp. of Barometer.								Weather.
1842.	9 A. M.	12 M.	2 P. M.	6. P. M.	T 9 A.M.	t. 9 A.M.	T. 12 M.	t. 12 M.	T 2 P.M.	t. 2 P.M.	T. 6 P.M.	t. 6 P.M.	
June 3.	30.448	30.446	30.432	30.412	62	62	64	64	64	64	64	64	Clear.
June 4.	30.348	30.292	30.270	30.188	62	62	63	64	64	64	65	65	Clouds.
June 5.	30.130	30.050	30.020	30.300		60		68		71		72	"
June 6.	30.108	30.128	30.150	30.320	66	66	67	67	67	67	65	65	Clear.
June 7.	30.574	30.568	30.564	30.650	63	63	64	64	64	64	63	63	"
June 8.	30.820	30.810	30.806	30.762	62	62	63	63	63	63	64	64	Cloudy.
June 9.	30.464	30.324	30.280	30.162	62	62	63	63	63	63	63	63	"
June 10.	30.012	29.956	29.930		62	62	63	64	65	66			Rain.
June 11.	30.050	30.098	30.120	30.296	64	64	63	63	63	63	63	63	Cloudy.
June 12.	30.440	30.430	30.410	30.390		53		56		59		61	Clear.
June 13.	30.368	30.344	30.330	30.346	58	58	60	60	62	62	63	63	Cloudy.
June 14.	30.416	30.424	30.418	30.424	64	64	66	66	67	67	67	67	Fair.

Date.	Barometer.				Temp. of Barometer.								Weather.
1842.	9 A. M.	12 M.	2 P. M.	6 P. M.	T. 9 A. M.	t. 9 A. M.	T. 12 M.	t. 12 M.	T. 2 P.M.	t. 2 P.M.	T. 6 P.M.	t. 6 P.M.	
June 15.	30.396	30.384	30.346	30.344	66	66	67	67	67	67	68	68	Clouds.
June 16.	30.218	30.166	30.152	30.154	67	67	67	67	68	68	69	69	"
June 17.	30.192	29.196	30.198	30.206	67	67	68	68	69	69	69	69	Fair.
June 18.	30.292	30.308	29.274	30.242	65	65	66	66	67	67	67	67	Rain.
June 19.	30.050	30.040	30.030	30.000		65		67		68		70	Cloudy.
June 20.	30.070	30.120	30.140	30.180	69	69	72	72	72	72	72	72	Clear.
June 21.	30.322	30.328	30.320	30.258	67	67	68	68	70	70	72	72	"
June 22.	30.186	30.150	30.130	30.080	68	68	72	72	73	73	74	74	Clouds.
June 23.	30.198	30.190	30.190	30.172	70	69	69	68	68	68	70	70	"
June 24.	30.260	30.160	30.158	30.158	67	67	68	68	68	68	68	68	Fair.
June 25.	30.292	30.204	30.200	30.166	66	66	67	68	67	67	67	67	"
June 26.	29.890	29.880	29.800	29.930		65		70		70		72	"
June 27.	30.162	.30.190	30.206	30.238	66	66	67	67	67	67	66	66	Rain.
June 28.	30.192	30.194	30.170	30.166	65	65	67	67	67	67	67	66	Cloudy.
June 29.	30.112	30.144	30.170	30.292	66	66	68	69	69	69	70	70	Fair.
June 30.	30.400	30.404	30.364	30.324	68	68	70	71	72	72	72	73	Clear.
July 1.	30.304	30.300	30.300	30.302	71	71	76	76	77	77	76	76	S.W. Fair.
July 2.	30.410	30.380	30.370	30.360	75	75	79	79	79	80	79	79	S. Fair.
July 3.	30.400	30.370	30.360	30.800		74		78		78		73	S.W. "
July 4.	30.330	30.320	30.290	30.280		74		77		78		79	S.W. "
July 5.	30.250	30.244	30.228	30.210	75	75	76	76	77	77	77	77	S. Cloudy.
July 6.		30.240	30.228	30.272			76	76	76	77	74	75	S.W. "
July 7.	30.518	30.510	30.500	30.500	67	68	70	70	70	70	70	69	S. Clear.
July 8.	30.466	30.444			67	67	69	69					S. Fog.
July 9.	30.236	30.240	30.250	30.324	72	72	73	73	74	75	74	74	W. Fair.
July 10.	30.480	30.490	30.480	30.480		68		69		69		68	S. Clear.
July 11.	30.510	30.528	30.518	30.472	68	68	70	70	72	71	71	70	S. Fair.
July 12.	30.406	30.380	30.358	30.280	69	69	72	73	74	75	75	75	W. "
July 13.	30.248	30.232	30.212	30.190	75	76	79	80	81	82	83	84	W. "
July 14.	30.204	30.196	30.198	30.190	78	78	81	82	82	83	84	84	W. "
July 15.		30.290	30.290	30.298			80	80	80	79	79	78	S. Cloudy.
July 16.	30.328	30.302	30.270	30.220	75	75	76	76	76	76	76	75	S. "
July 17.	30.150	30.130	30.130	30.130		72		74		75		75	S. Clear.
July 18.	30.168	30.172	30.172	30.172	75	75	76	76	77	77	77	77	S. "
July 19.	30.188	30.150	30.142	30.103	75	75	77	77	78	78	78	78	S. Cloudy.
July 20.	30.108	30.152	30.190	30.286	77	77	77	77	77	77	77	76	N.W. Clear.
July 21.	30.592	30.560	30.544	30.522	69	68	70	71	71	72	72	72	N.W. Fair.
July 22.	30.542	30.526	30.484	30.428	70	70	72	72	73	73	74	74	S.W. Fair.
July 23.	30.452	30.436	30.410	30.376	71	71	75	76	77	77	79	79	W. "
July 24.	30.320	30.300	30.260	30.270		77		81		81		77	W. "
July 25.	30.474			30.400	69	69					71	70	N. "
July 26.	30.454	30.300	30.262	30.202	70	69	72	73	73	74	76	77	W. "
July 27.	30.172	30.168	30.204	30.300	76	76	78	79	77	77	76	76	N. Clear.
July 28.	30.430	30.412	30.406	30.402	74	74	75	75	75	75	76	76	S. Fair.
July 29.	30.484	30.444	30.436	30.338	72	72	73	73	73	73	73	73	S. "
July 30.	30.042	29.990	29.970	29.960	75	76	79	80	81	82	82	82	E. Rain.
July 31.	29.990	30.040	30.070	30.100		66		67		68		67	S E. "

Date.	Barometer.				Temp. of Barometer.								Weather.
1842.	9 A. M.	12 M.	2 P. M.	6 P. M.	T.	t.	T.	t.	T.	t.	T.	t.	
					9 A.M.	9 A.M.	12 M.	12 M.	2 P.M.	2 P.M.	6 P.M.	6 P.M.	
Aug. 1.	30.252	30.272	30.278	30.302	65	65	66	66	66	66	67	66	N. W. Fair.
Aug. 2.	30.132	30.432	30.432	30.430	63	63	66	66	67	67	67	67	E. Fair.
Aug. 3.	30.534	30.536	30.518	30.520	65	65	68	68	69	69	68	68	S. Clear.
Aug. 4.	30.578	30.576	30.554	30.528	68	67	68	67	67	67	67	66	E. Cloudy.
Aug. 5.	30.548	30.564	30.540	30.532	66	66	67	67	67	67	67	67	E. "
Aug. 6.	30.500	30.592	30.578	30.562			68	68	68	68	69	69	E. "
Aug. 7.	30.430	30.410	30.380	30.350		68		69		70		69	S. Rain.
Aug. 8.	30.318	30.322	30.302	30.296	69	69	70	70	70	70	71	71	S. Cloudy.
Aug. 9.	30.420	30.436	30.422	30.428	70	70	72	72	73	73	72	72	N. Fair.
Aug. 10.	30.492	30.502	30.478	30.458	70	70	72	72	73	72	72	71	S. Cloudy.
Aug. 11.	30.166	30.460	30.454	30.424	70	70	72	72	73	72	73	73	S. Clear.
Aug. 12.	30.460	30.502	30.502	30.504	71	71	73	73	73	73	73	72	S. E. Cloudy.
Aug. 13.	30.548	30.542	30.540	30.500	69	69	69	69	69	68	68	67	N. Rain.
Aug. 14.	30.320	30.250	30.260	30.260		64		67		68		68	E. Fair.
Aug. 15.	30.300	30.294	30.292	30.292	67	67	69	69	70	70	71	72	E. "
Aug. 16.	30.302	30.296	30.300	30.300	69	69	69	69	69	69	69	69	E. "
Aug. 17.	30.312	30.306	30.304	30.292	69	69	71	71	72	72	72	72	S. W. "
Aug. 18.	30.308		30.242	30.250	70	70			73	72	72	72	S. Cloudy.
Aug. 19.	30.260	30.238	30.196	30.184	72	72	74	74	76	76	77	77	W. Fair.
Aug. 20.	30.298	30.300	30.300	30.332	72	72	74	74	74	74	74	74	N. W. Clear.
Aug. 21.	30.450	30.470	30.480	30.470		67		69		69		69	N. "
Aug. 22.	30.624	30.624	30.600	30.604	69	69	71	72	72	72	72	72	S. "
Aug. 23.	30.692	30.686	30.666	30.666	68	68	72	72	72	72	72	72	S. "
Aug. 24.	30.662	30.640	30.616	30.562	68	68	71	72	72	72	72	71	S. Fair.
Aug. 25.	30.476	30.462	30.440	30.420	68	68	72	72	72	73	72	73	S. E. Rain.
Aug. 26.	30.372	30.350	30.344	30.300	72	72	74	75	75	75	74	74	S. Misty.
Aug. 27.	30.300	30.258	30.234	30.218	74	73	75	75	76	76	75	74	S. Rain.
Aug. 28.	30.120	30.090	30.050	30.030		70		69		69		69	E. Cloudy.
Aug. 29.	30.020	30.042	30.058	30.156	72	72	74	74	74	74	72	71	N. W. Clear.
Aug. 30.	30.384	30.392	30.390	30.412	66	66	68	68	69	69	69	68	S. "
Aug. 31.	30.552	30.542	30.526	30.496	66	66	68	68	69	69	69	68	S. Cloudy.
Sept. 1.	30.496	30.456	30.432	30.402	67	67	70	71	72	72	72	72	S. W. Clear.
Sept. 2.	30.362	30.348	30.320	30.308	71	71	74	75	75	75	75	75	Fair.
Sept. 3.	30.316		30.210	30.232	73	73			77	77	77	77	Rain.
Sept. 4.	30.450	30.470	30.440	30.420		68		67		67		67	Clear.
Sept. 5.	30.100	30.094	30.112		69	70	70	70	70	70			"
Sept. 6.	30.488	30.362	30.300	30.338	66	66	67	67	68	68	68	68	"
Sept. 7.	30.298	30.264	30.220	30.196	65	65	66	66	67	67	67	67	Fair.
Sept. 8.	30.364	30.354	30.352	30.400	64	64	66	66	66	66	66	66	Cloudy.
Sept. 9.	30.296	30.200	30.200	30.208	65	64	66	65	66	65	65	64	"
Sept. 10.	30.408	30.388	30.376	30.400	62	62	63	64	64	64	64	63	Clear.
Sept. 11.	30.339	30.230	30.180	30.080		58		60		60		62	Fair.
Sept. 12.	29.948	29.930	29.930	29.942	64	64	67	67	68	68	68	68	"
Sept. 13.	29.948	29.900	29.954	30.082	66	66	67	67	67	67	67	67	Cloudy.
Sept. 14.	30.346	30.376	30.064	30.374	65	65	67	67	66	66	65	64	Clear.
Sept. 15.	30.432	30.424	30.424	30.410	63	63	64	64	64	64	64	64	Rain.
Sept. 16.	30.328	30.296	30.300	30.252	62	62	63	63	63	64	64	64	Clouds.

Date.	Barometer.				Temp. of Barometer.								Weather.
1842.	9 A. M.	12 M.	2 P. M.	6 P. M.	T. 9 A.M.	t. 9 A.M.	T. 12 M.	t. 12 M.	T. 2 P.M.	t. 2 P.M.	T. 6 P.M.	t. 6 P.M.	
Sept. 17.	30.250	30.250	30.250	30.246	62	62	63	64	64	65	64	64	Clear.
Sept. 18.	30.220	30.170	30.150	30.140		57		58		60		60	Clouds.
Sept. 19.	30.152	30.170	30.172	30.228	62	62	63	63	63	63	63	63	Clear.
Sept. 20.	30.326	30.332	30.300	30.300	59	59	61	61	61	61	62	62	"
Sept. 21.	30.146	30.104	29.994	29.946	58	57	61	61	62	62	62	62	"
Sept. 22.	30.041	30.036	30.036	30.094	57	58	60	60	60	61	60	60	Clouds.
Sept. 23.	30.224	30.226	30.230	30.290	58	60	60	61	62	62	61		Clear.
Sept. 24.	30.340	30.354	30.336	30.348	56	57	60	61	61	61	60		"
Sept. 25.	30.470	30.440	30.430	30.480		50		52		53		53	"
Sept. 26.	30.560	30.522	30.510	30.466	61	61	63	64	64	64	63		"
Sept. 27.	30.434	30.398	30.334	30.236	61	62	64	65	65	65	65		"
Sept. 28.	30.134	30.142	30.128	30.178	62	63	66	66	66	66	67		"
Sept. 29.	30.358	30.372	30.372	30.400	63	63	65	66	66	66	66		Cloudy.
Sept. 30.	30.372	30.280	30.270	30.248	62	62	63	64	64	64	64	63	Clear.
Oct. 1.	30.220	30.150	30.138	30.122	61	61	64	64	65	65	65	65	"
Oct. 2.	29.970	30.930	29.900	29.960		58		60		61		62	"
Oct. 3.	30.100	30.098	30.072	30.100	62	62	64	65	65	65	64	64	"
Oct. 4.	30.180	30.176	30.174	30.218	61	61	63	64	64	65	63	63	"
Oct. 5.	30.352	30.382	30.400	30.444	58	59	63	64	64	64	63	62	"
Oct. 6.	30.608	30.598	30.588	30.518	58	60	62	62	64	64	62	61	"
Oct. 7.	30.522	30.408	30.450	30.380	57	59	62	63	63	63	63	62	"
Oct. 8.	30.270	30.212	30.206	30.176	59	60	63	63	63	63	63	63	Cloudy.
Oct. 9.	30.050	29.990	29.930	29.800		59		61		62		62	Rain.
Oct. 10.	30.090	30.166	30.176	30.228	63	63	64	64	64	65	63	63	Clear.
Oct. 11.	30.122	30.040	30.014	29.952	58	59	63	64	63	64	63	62	"
Oct. 12.	29.900	29.922	29.940	30.080	62	63	64	64	64	64	63	62	"
Oct. 13.	30.316	30.336	30.331	30.372	56	57	62	63	63	63	62	62	"
Oct. 14.	30.386	30.348	30.320	30.284	60	62	63	64	64	64	63	63	Cloudy.
Oct. 15.	29.752	29.693	29.700	29.802	61	62	63	63	63	63	62	62	Clear.
Oct. 16.	30.050	30.080	30.100	30.120		52		53		55		51	Cloudy.
Oct. 17.	30.222	30.298	30.332	30.438	59	59	62	63	62	63	62	61	Clear.
Oct. 18.	30.390	30.300	30.214	30.032	60	60	62	62	61	61	63	62	Rain.
Oct. 19.	30.116	30.130	30.172	30.278	59	59	63	63	62	62	61	61	Clear.
Oct. 20.	30.362	30.344	30.322	30.399	57	58	62	63	61	61	61	61	Cloudy.
Oct. 21.	30.474	30.434	30.432	30.414	59	62	62	64	62	62	61	61	"
Oct. 22.	30.230	30.176	30.102	30.046	58	60	61	63	61	62	60	60	Rain.
Oct. 23.	29.950	30.030	30.070	30.180		50		52		52		50	Clear.
Oct. 24.	30.408	30.404	30.338	30.332	57	58	60	61	60	60	62	62	Cloudy.
Oct. 25.	30.236	30.158	30.086	29.982	60	60	64	64	62	62	62	62	Rain.
Oct. 26.	30.150	30.152	30.170	30.200	61	62	62	62	63	63	62	62	Clear.
Oct. 27.	30.372	30.392	30.392	30.512	59	60	62	62	61	62	61	61	"
Oct. 28.	30.650	30.748	30.740	30.700	59	60	60	62	62	63	63	64	"
Oct. 29.	30.590	30.554	30.528	30.552	58	59	61	62	61	62	62	62	"
Oct. 30.	30.660	30.649	30.630	30.660		42		41		40		43	"
Oct. 31.	30.702	30.700	30.660	30.648	49	50	59	62	60	60	59	61	Cloudy.
Nov. 1.	30.480	30.406	30.366	30.382	50	52	61	64	61	63	62	62	Fair.
Nov. 2.	30.594	30.494	30.464	30.556	58	61	61	63	62	64		62	Clear.
Nov. 3.	30.672	30.630	30.600	30.594	59	61	61	63	63	64	61	61	"

Meteorological Register, kept by Prof. IRA YOUNG, *at Dartmouth College—latitude, N.* 43° 42′ 26″.8.

Date. 1840.	Therm. Sunrise.	Therm. 1½ P. M.	Therm. 9½ P. M.	Cloudiness. Sunrise.	Cloudiness. 1½ F. M.	Cloudiness. 9½ P. M.	Winds. Sunrise.	Winds. 1½ P. M.	Winds. 9½ P. M.	Barom. & Ther. Sunrise.		Barom. & Ther. 9½ P. M.		Remarks.
June 1.	50	54	45	9	10	0	N.	N.	N.W.	29.57		29.55		Slight rain, M.to 3 P.M.
June 2.	39	61	53	0	6	10	"	S.E.	S.E.	29.80		29.80		
June 3.	50	56	58	9	10	10	S.E.	"	"	29.75		29.50		Rain from 7 A. M. thro'
June 4.	60	72	65	10	10	9	"	"	"	29.40		29.30		day&n't until7A.M,.67.
June 5.	62	72	60	9	4	0	S.W.	W.	N.W.	29.28		29.50		Rain from 7 P.M. (4th.)
June 6.	52	72	70	9	4	2	N.W.	S.E.	S.E.	29.52		29.52		until 7 A.M. 1.10.
June 7.	59	61	50	10	10	6	S.W.	N.W.	N.	29.60		29.72		Rain during the day,.10.
June 8.	50	63	56	5	0	0	N.W.	N.	N.	29.75		29.85		
June 9.	51	66	60	0	4	0	"	N.W.	N.W.	29.90		29.93		
June 10.	51	77	65	0	4	0	"	"	"	29.95		29.85		
June 11.	64	81	68	0	4	4	"	"	"	29.82		29.60		
June 12.	60	79	68	4	4	8	S.W.	"	"	29.57		29.50		
June 13.	61	72	62	9	9	3	N.W.	"	"	29.34		29.50		Th. sh'r fr.10 P.M.,.25.
June 14.	52	66	50	0	4	6	"	"	"	29.60		29.59		Sh'r from 9½ P.M., .05.
June 15.	54	64	49	6	5	0	"	"	"	29.53		29.58		
June 16.	44	65	55	0	4	1	"	"	"	29.64		29.72		
June 17.	48	69	58	0	2	1	"	"	"	29.77		29.80		
June 18.	49	68	54	0	6	8	S.W.	S.E.	S·E.	29.75		29.53		Th. sh'r fr.10½P.M.,.20.
June 19.	54	61	54	5	6	9	"	N.E.	N.E.	29.45		29.20		Rain from 10 P.M., .25.
June 20.	52	63	57	9	7	8	N.E.	N.W.	N.W.	29.10		29.43		
June 21.	52	72	68	1	1	7	N.W.	S.W.	S.W.	29.46		29.48		Slight sh'r from 5½P.M.
June 22.	64	74	60	8	4	0	S.E.	"	"	29.50		29.68		rain fr. 10 P. M. thro'
June 23.	56	72	63	Fog.	2	0	S.W.	"	"	29.74		29.77		night until 9A.M., .60.
June 24.	54	82	66	0	0	3	"	"	"	29.76		29.63		
June 25.	62	73	60	3	0	0	"	N.W.	"	29.67		29.70		
June 26.	52	73	64	1	1	2	N.E.	N.	"	29.74		29.18		
June 27.	53	70	67	1	7	8	S.E.	S.E.	S.E.	29.78		29.71		
June 28.	65	76	72	8	6	0	"	S.E.	S.W.	29.62		29.59		Aurora Borealis, faint.
June 29.	65	86	74	Fog.	0	6	S.	S.	"	29.58		29.58		Squall fr. 6½ to 7½P.M.,
June 30.	71	84	73	Fog.	3	8	N.W.	S.W.	"	29.51		29.56		and ther. 80° at 3 P.M.,
July 1.	64	71	59	8	6	4	N.E.	N.	N.	29.57	68°	29.67	67°	barom. 29.50 at 6 P. M.
July 2.	57	70	56	2	2	0	N.	N.	N.	29.72	65	29.88	67	On 30th, slight sh'r at 8
July 3.	48	68	59	0	4	3	N.	N.E.	N.	29.90	62	29.87	66	and 10 A. M., .04.
July 4.	55	74	64	3	0	0	N.	N.	N.	29.88	63	29.92	69	Aurora Borealis.
July 5.	52	77	70	0	1	1	N.	N.	S.E.	29.98	64	29.98	72	Baro. 30.00 at 10 A.M.
July 6.	60	77	66	2	4	5	S.E.	S.E.	"	29.99	67	29.97	71	
July 7.	60	70	66	7	8	9	"	"	"	29.92	68	29.86	70	Slight rain.
July 8.	57	77	70	3	3	8	N.E.	N.E.	S.W.	29.84	66	29.70	73	Th. sh'r fr. midn't, .82.
July 9.	68	80	69	5	3	4	S.W.	S.W.	"	29.55	72	29.48	72	Showery, with th., .08.
July 10.	66	72	62	8	0	0	N.W.	N.W.	N.W.	29.47	70	29.70	70	
July 11.	54	82	72	0	0	1	W.	W.	W.	29.72	65	29.68	74	
July 12.	61	85	74	1	1	0	S.W.	S.W.	S.W.	29.68	69	29.67	76	Atmosphere smoky.
July 13.	65	76	73	Fog.	8	9	S.E.	S.E.	S.	29.50	72	29.39	73	Slight rain, .03.

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Date. 1840.	Therm.			Cloudiness			Winds.			Barom. & Ther. Sunrise.		9½ P. M.		Remarks.
	Sunrise.	1½ P. M.	9½ P. M.	Sunrise.	1½ P. M.	9½ P. M.	Sunrise.	1½ P. M.	9½ P. M.		°		°	
July 14.	72	82	71	4	7	0	S.W.	W.	W.	29.32	72	29.49	73	Shower from 1 to 2 P.
July 15.	62	86	74	3	0	0	N.W.	"	"	29.55	68	29.66	76	[M., .10.
July 16.	64	88	74	Fog.	1	0	W.	S.	S.	29.70	67	29.67	78	
July 17.	70	92	77	4	5	8	S.	"	N.W.	29.67	74	29.65	77	Thunder sho'r from 10¼
July 18.	72	82	76	10	4	1	"	"	S.	29.65	72	29.67	78	[P. M., .20.
July 19.	72	80	62	9	3	8	"	W.	N.W.	29.55	73	29.57	73	Barom. 29.40, 3 P. M.;
July 20.	53	69	59	2	0	0	N.W.	N.W.	"	29.62	68	29.66	69	[at 5, thund. & high W.
July 21.	52	74	63	2	3	0	"	"	"	29.64	63	29.75	69	
July 22.	54	77	66	Fog.	4	0	"	"	S.W.	29.82	65	29.78	71	
July 23.	59	80	68	1	4	10	S.	S.	S. E.	29.77	67	29.63	72	Rain from 8½ P. M., .60.
July 24.	64	70	65	10	10	9	S. E.	S. E.	N.W.	29.43	69	29.54	71	Rain con. to 5 P.M., .57.
July 25.	59	74	63	0	0	1	N.W.	N.W.	"	29.69	67	29.83	70	
July 26.	54	74	65	Fog.	7	1	"	"	"	29.85	65	29.89	70	
July 27.	61	82	72	Fog.	2	0	"	"	S. E.	29.89	67	29.86	74	
July 28.	66	83	72	1	3	10	S. E.	S.	"	29.78	69	29.47	74	Sho'r from 8¾ P.M., .65.
July 29.	67	75	64	0	3	1	N.W.	N.W.	N.W.	29.47	72	29.65	66	Faint Aurora Borealis.
July 30.	65	78	64	Fog.	3	0	"	"	"	29.72	73	29.77	68	
July 31.	58	77	68	0	7	2	S.W.	S.W.	S.W.	29.82	65	29.81	71	
Aug. 1.	63	71	66	4	8	7	S. E.	E.	E.	29.80	68	29.75	70	[.10.
Aug. 2.	60	79	70	2	2	8	S.W.	S.W.	S. E.	29.74	67	29.65	71	Rain from 4½ to 8½ P.M.,
Aug. 3.	69	77	71	7	9	9	"	"	S.W.	29.59	70	29.52	72	" 1 P. M., .08.
Aug. 4.	65	79	75	0	1	8	S.	"	"	29.52	71	29.41	75	
Aug. 5.	64	74	65	0	0	1	W.	W.	N.W.	29.43	71	29.44	76	[M., .10.
Aug. 6.	58	70	67	0	1	8	N.W.	"	S.W.	29.42	66	29.34	72	Rain from noon to 1 P.
Aug. 7.	60	70	59	0	3	0	S.W.	S.W.	N.W.	29.34	71	29.44	64	
Aug. 8.	50	75	58	4	3	0	N.W.	N.W.	"	29.48	62	29.55	68	Sh'r from 5 to 6P.M.,.09.
Aug. 9.	54	70	58	Fog.	6	1	"	"	"	29.66	63	29.77	65	Slight rain from 5 P. M.
Aug. 10.	53	72	61	"	3	0	"	"	"	29.83	59	29.83	67	
Aug. 11.	52	64	66	"	5	8	"	"	"	29.80	62	29.68	67	Showery, .10.
Aug. 12.	60	78	68	"	8	8	S.W.	S.	S.	29.66	65	29.60	70	
Aug. 13.	64	78	70	"	5	10	S.	"	"	29.52	66	29.50	73	Rain from 7 P. M., thro.
Aug. 14.	70	75	66	10	6	0	"	W.	W.	29.30	72	29.50	70	night, until 7 A.M., 1.50.
Aug. 15.	60	72	63	0	0	0	W.	"	"	29.60	63	29.80	69	
Aug. 16.	52	70	62	Fog.	6	0	"	S.W.	"	29.93	62	29.97	67	
Aug. 17.	54	78	69	Fog.	0	0	S.W.	"	S.W.	30.04	64	30.02	70	Therm. 80° at 4 P. M.
Aug. 18.	64	79	70	3	1	0	"	"	W.	30.13	67	29.95	74	Sl't sho'r at 3 A.M., .05.
Aug. 19.	65	82	72	7	4	1	"	"	S.W.	29.90	68	29.79	74	Therm. 84° at 3½ P. M.
Aug. 20.	64	82	70	Fog.	1	0	"	"	"	29.78	68	29.70	73	
Aug. 21.	65	86	73	Fog.	3	1	"	"	"	29.71	69	29.70	76	[rain, 8½ P. M.
Aug. 22.	65	86	76	1	3	3	"	"	"	29.69	70	29.63	76	Thun. and light., slight
Aug. 23.	71	79	70	3	3	2	S.	S.	"	29.57	72	29.46	73	Light sh'rs thro. the day,
Aug. 24.	67	76	66	1	4	3	S.W.	S.W.	N.W.	29.45	70	29.57	70	[.10.
Aug. 25.	68	71	62	7	6	0	N.W.	N.W.	"	29.62	66	29.74	66	Aurora Borealis.
Aug. 26.	56	75	67	0	5	8	"	"	"	29.78	62	29.78	70	
Aug. 27.	60	76	69	6	6	6	"	S.W.	S.E.	29.79	66	29.78	71	
Aug. 28.	65	76	68	7	6	6	S. E.	S.E.	"	29.80	68	29.83	72	

Date. 1840.	Therm. Sunrise	Therm. 1½ P.M.	Therm. 9½ P.M.	Cloudiness Sunrise	Cloudiness 1½ P.M.	Cloudiness 9½ P.M.	Winds Sunrise	Winds 1½ P.M.	Winds 9½ P.M.	Barom. & Ther. Sunrise.		Barom. & Ther. 9½ P. M.		Remarks.
Aug. 29.	66	79	70	6	0	0	S. E.	S. E.	S.	29.84	69°	29.84	72°	
Aug. 30.	67	71	69	8	8	9	"	S.	S.	29.79	64	29.66	69	[.10—windy eve.
Aug. 31.	69	81	66	9	1	0	"	S.W.	S.W.	29.56	69	29.59	70	Rain from 2 to 4 A. M.,
Sept. 1.	55	71	59	0	0	3	N.W.	N.W.	N.W.	29.60	67	29.63	68	Evening, hazy.
Sept. 2.	54	66	63	7	4	9	S.W.	S.	S.W.	29.55	63	29.43	66	
Sept. 3.	51	64	52	1	0	0	W.	W.	W.	29.50	63	29.72	66	
Sept. 4.	41	65	56	Fog.	0	0	N.	N.	N.	29.85	73	29.85	71	
Sept. 5.	44	63	58	F.	7	9	N.	S. E.	N. E.	29.84	62	29.67	63	Rain from 7 P. M. to
Sept. 6.	56	63	58	7	7	0	N.W.	N.W.	N.	29.65	62	29.76	70	past midnight, .12.
Sept. 7.	49	73	59	F.	0	0	S.W.	S.W.	S.W.	29.85	63	29.83	67	
Sept. 8.	48	74	68	F.	5	7	N.W.	"	"	29.79	63	29.62	70	
Sept. 9.	63	78	70	3	4	6	S.W.	"	S.	29.56	68	29.47	73	Thunder and lightning
Sept. 10.	66	68	61	0	8	7	S.	S.	S.	29.45	70	29.43	65	in the evening.
Sept. 11.	58	59	52	7	6	5	S.	N.W.	N.W.	29.39	64	29.66	71	Sh'r from 2 A. M. 1.01.
Sept. 12.	47	54	48	3	3	3	N.W.	"	"	29.73	61	29.89	59	Sh'rs, thu. at 9 & 11 A.
Sept. 13.	36	62	43	F.	1	0	"	"	"	29.95	54	29.95	60	M. & 1 P.M.,(11th).50.
Sept. 14.	32	65	50	F.	6	6	"	"	S.W.	29.90	54	29.71	58	Frost,first in the seas'n.
Sept. 15.	44	72	50	F.	3	0	"	"	N.W.	29.65	56	29.71	64	
Sept. 16.	43	78	57	F.	0	2	"	"	"	29.75	59	29.79	66	
Sept. 17.	44	78	59	0	2	3	"	S.W.	S.W.	29.78	62	29.65	67	
Sept. 18.	60	67	62	10	10	10	S. E.	S. E.	S. E.	29.60	65	29.55	67	Rain from 4 A.M.till.10
Sept. 19.	62	66	53	10	0	7	"	S.W.	S.W.	29.42	65	29.35	67	A. M. next day, 3.30.
Sept. 20.	52	59	52	7	9	9	S.	S.	N.W.	29.15	62	29.15	62	Barom. 29.05 at 4 P.M.
Sept. 21.	45	49	40	9	4	8	N.W.	N.W.	"	29.26	60	29.67	69	[Rain, .10.
Sept. 22.	39	48	38	8	6	8	"	"	"	29.79	57	29.86	59	
Sept. 23.	40	62	49	8	4	1	W.	W.	W.	29.76	55	29.94	72	Rain before day, .10.
Sept. 24.	44	62	42	7	0	0	W.	N.W.	N.W.	29.99	62	30.03	62	
Sept. 25.	41	61	49	F.	2	0	N.W.	"	W.	30.02	58	29.94	64	
Sept. 26.	45	62	51	F.	0	0	W.	W.	"	29.80	60	29.77	67	[.50.
Sept. 27.	52	61	51	6	10	2	S.	S.	N.W.	29.67	62	29.63	62	Rain from 1 to 7 P. M.,
Sept. 28.	41	61	39	0	1	0	N.W.	N.W.	"	29.69	59	29.86	71	
Sept. 29.	34	62	45	F.	0	1	"	"	"	29.85	60	29.81	64	[the day, .60.
Sept. 30.	44	60	52	F.	9	10	"	S. E.	S. E.	29.75	58	29.81	65	Rain from 7 A. M. thro.
Oct. 1.	53	51	47	10	10	10	S. E.	E.	E.	29.81	62	29.95	68	" thro. the night, .38;
Oct. 2.	48	51	55	10	9	9	"	S. E.	S. E.	29.90	62	29.84	60	thro.day and night,.35.
Oct. 3.	47	68	47	9	10	4	"	S.	N.W.	29.65	60	29.72	61	Rain in night,.15; from
Oct. 4.	32	63	48	0	0	1	N.W.	S.W.	S.W.	29.76	54	29.72	61	[1 to 5 P. M., .18.
Oct. 5.	39	70	50	F.	0	0	S.	S.	"	29.72	57	29.63	63	
Oct. 6.	44	71	51	0	0	0	S.W.	S.W.	"	29.62	61	29.68	66	
Oct. 7.	38	61	41	0	0	0	"	"	"	29.82	61	29.93	63	
Oct. 8.	33	66	48	0	0	0	S. E.	"	"	29.94	57	29.86	63	
Oct. 9.	46	49	31	8	7	0	N.W.	N.W.	N.W.	29.87	58	30.03	54	
Oct. 10.	21	50	33	0	0	1	N.	N.	N.	30.10	49	29.83	67	
Oct. 11.	42	54	56	8	10	8	S. E.	S. E.	S.W.	29.60	54	29.10	56	Rain from 1 P.M., .10.
Oct. 12.	52	52	40	6	6	7	W.	N.W.	N.W.	29.10	56	29.41	55	Windy.
Oct. 13.	39	51	33	8	2	2	N.W.	"	"	29.53	51	29.55	52	
Oct. 14.	31	69	42	0	5	6	"	S.W.	S.W.	29.43	45	29.56	56	

Date. 1840.	Therm.			Cloudiness.			Winds.			Barom. & Ther. Sunrise.		Barom. & Ther. 9½ P. M.		Remarks.
	Sunrise	1½ P.M.	9½ P.M.	Sunrise	1½ P.M.	9½ P.M.	Sunrise	1½ P.M.	9½ P.M.		°		°	
Oct. 15.	31	52	29	0	2	0	N.W.	N.W.	N.W.	29.65	52	29.80	53	
Oct. 16.	32	39	34	1	8	8	"	"	"	29.81	48	29.98	48	
Oct. 17.	22	49	36	0	2	4	"	"	"	30.03	44	30.06	56	
Oct. 18.	37	55	47	6	7	8	S.W.	S.W.	S.W.	30.11	51	29.96	52	
Oct. 19.	48	60	59	8	7	9	"	"	"	29.88	52	29.68	56	Rain fr. 11 P. M. to 10
Oct. 20.	61	62	45	9	4	Fog.	S.	"	N.W.	29.61	60	29.75	64	A.M.,.16.Dense fog,ev.
Oct. 21.	41	56	47	F.	5	10	S.W.	S.E.	S.E.	29.74	59	29.36	56	Rain fr. 3 P.M. thro' nt.
Oct. 22.	44	45	31	8	2	0	N.W.	N.W.	N.W.	29.29	54	29.62	57	Aurora Borealis. [.30.
Oct. 23.	31	61	52	2	1	7	S.W.	S.	S.W.	29.54	50	29.44	68	Windy night.
Oct. 24.	40	47	27	4	1	0	W.	W.	W.	29.58	57	29.83	59	
Oct. 25.	31	44	34	8	8	8	S.E.	S.E.	S.E.	29.77	51	29.45	47	
Oct. 26.	30	36	32	9	9	8	"	"	N.W.	29.14	46	29.55	58	Snow from 2 A.M. to 4
Oct. 27.	30	39	24	4	4	2	N.W.	N.W.	"	29.75	49	29.96	57	P.M.—moist—5 inch.
Oct. 28.	30	39	34	9	9	10	S.E.	S.E.	S.E.	29.92	48	29.85	58	Snow and rain, .40.
Oct. 29.	35	44	54	9	10	10	"	"	"	29.84	51	29.34	65	Rain through day and
Oct. 30.	60	59	44	10	9	9	S.	N.W.	N.W.	29.18	67	29.37	63	night, to 3 A.M., 1.00.
Oct. 31.	40	48	34	9	8	0	N.W.	"	"	29.43	56	29.57	58	Aurora Borealis.
Nov. 1.	34	46	27	5	0	0	"	"	"	29.68	52	29.97	56	
Nov. 2.	23	46	31	1	0	0	"	"	"	30.03	48	30.06	74	
Nov. 3.	24	47	32	1	0	0	"	S.W.	S.W.	29.98	54	29.92	66	
Nov. 4.	31	47	36	F.	1	5	S.W.	"	S.E.	29.88	43	29.89	67	
Nov. 5.	37	47	31	8	3	1	E.	E.	"	29.82	56	29.72	60	
Nov. 6.	25	52	36	1	3	4	S.E.	S.E.	S.W.	29.72	52	29.79	64	
Nov. 7.	26	48	31	0	0	0	N.W.	"	S.E.	29.80	52	29.84	60	
Nov. 8.	37	44	41	8	8	7	S.E.	"	"	29.76	53	29.58	50	Rain from 10 P.M. thro'
Nov. 9.	41	43	41	10	10	10	N.E.	N.E.	N.E.	29.43	50	29.51	71	night and day, 2.30 in.
Nov. 10.	34	45	37	10	5	7	"	N.	N.	29.60	55	29.76	63	Windy.
Nov. 11.	34	43	38	6	7	8	"	N.E.	"	29.75	52	29.80	60	
Nov. 12.	37	47	42	7	8	10	N.	"	N.E.	29.67	51	29.47	51	Rain from 6 P.M. thro'
Nov. 13.	42	46	35	9	8	4	S.E.	N.W.	N.W.	29.35	49	29.43	56	night,to 11½ A.M.,.30.
Nov. 14.	31	42	31	1	1	4	N.W.	"	"	29.51	52	29.62	62	
Nov. 15.	32	34	25	10	10	0	S.E.	S.E.	"	29.34	50	29.32	47	Sleet from 3 A.M. to 3
Nov. 16.	18	37	27	0	5	6	N.W.	S.W.	S.W.	29.45	42	29.49	60	P.M.,.50. Barom.at 1½
Nov. 17.	21	40	29	1	4	9	S.W.	"	"	29.46	47	29.49	62	P.M. 29.23. Auro. Bor.
Nov. 18.	22	40	31	4	6	8	N.W.	N.W.	N.W.	29.47	48	29.35	56	
Nov. 19.	27	30	26	9	8	9	"	"	"	29.24	46	29.34	59	
Nov. 20.	26	31	21	9	7	0	"	"	"	29.45	46	29.71	63	Aurora Borealis.
Nov. 21.	23	30	21	7	6	2	"	"	"	29.74	48	29.86	60	Hazy.
Nov. 22.	22	28	24	10	10	10	"	"	N.E.	29.82	46	29.58	41	Snow thro' d.&n. 6½ in.
Nov. 23.	29	36	32	10	10	9	N.E.	"	N.W.	29.27	39	29.35	55	Rain and sleet, .20.
Nov. 24.	25	40	24	3	5	7	N.W.	S.W.	"	29.62	45	29.77	47	Good sleighing.
Nov. 25.	26	40	32	9	8	8	N.E.	S.E.	S.E.	29.67	42	29.45	64	Snow from sunr. 1 in.
Nov. 26.	26	41	28	3	4	10	"	S.W.	N.E.	29.29	49	29.47	60	Snow from 6 P.M.1½in.
Nov. 27.	17	27	13	1	8	4	N.	N.W.	N.W.	29.56	47	29.74	52	Hazy evening.
Nov. 28.	16	30	28	7	6	8	S.W.	S.W.	S.W.	29.68	40	29.67	51	Hazy evening.
Nov. 29.	27	45	30	3	3	0	N.	"	N.W.	29.64	44	29.34	47	
Nov. 30.	43	44	26	9	4	2	W.	"	S.W.	29.26	44	29.42	53	High wind fr. 5½ P.M.

Barometrical Register kept by John Town, Esq., Deputy Secretary, in the Office of Secretary of State, at State House, Concord, N. H.

Date. 1842.	Hour.	Barom	T.	Wind.	Weath.	Date. 1842.	Hour.	Barom	T.	Wind.	Weath.
July 11.	9 A. M.	30.140	70	S.W.	Fair.	July 27.	6 A. M.	29.80	74	W.	Fair.
"	12 M.	30.154	74	"	"	"	10 A. M.	29.80	81	"	"
"	2 P. M.	30.12	75	S. E.	"	"	12 M.	29.80	80	"	Rainy.
"	6½ P. M.	30.08	75	"	"	"	2 P. M.	29.80	77	"	Cloudy
July 12.	6 A. M.	30.07	70	"	"	"	6 P. M.	29.85	78	"	Fair.
"	10 A. M.	30.08	75	"	"	July 28.	6 A. M.	30.	72	"	"
"	12 M.	30.	77	"	"	"	10 A. M.	30.04	76	"	"
"	2 P. M.	29.93	80	S.W.	"	"	12 M.	30.	76	"	"
"	6 P. M.	29.93	80	"	"	"	2 P. M.	30.05	77	"	"
July 13.	6 A. M.	29.84	70	W.	"	July 29.	6 A. M.	30.08	70	N.W.	Cloudy
"	10 A. M.	29.90	79	"	"	"	10 A. M.	30.06	70	"	"
"	12 M.	29.90	82	"	"	"	12 M.	30.03	74	S.	Fair.
"	2 P. M.	29.88	84	"	"	"	2 P. M.	30.	76	"	"
"	6 P. M.	29.85	85	"	"	"	6 P. M.	29.94	76	"	"
July 14.	6 A. M.	29.85	76	"	"	July 30.	6 A. M.	29.74	73	S.W.	"
"	10 A. M.	29.85	82	"	"	"	10 A. M.	29.60	80	"	"
"	12 M.	29.80	86	S.	"	"	12 M.	29.60	82	W.	"
"	2 P. M.	29.85	86	"	"	"	2 P. M.	29.54	82	"	"
"	6 P. M.	29.77	83	S.W.	"	"	6 P. M.	29.56	80	N.W.	Sho'ry.
July 15.	6 A. M.	29.90	79	N.W.	"	Aug. 1.	6 A. M.	29.77	67	"	Fair.
"	10 A. M.	29.92	77	"	Cloudy.	"	10 A. M.	29.95	72	"	"
"	12 M.	29.95	76	"	"	"	12 M.	29.87	72	"	"
"	2 P. M.	29.92	77	"	"	"	2 P. M.	29.87	71	"	"
"	6 P. M.	29.95	76	"	Fair.	"	6 P. M.	29.92	70	"	"
July 16.	6 A. M.	29.95	74	"	Cloudy.	Aug. 2.	6 A. M.	30.09	64	"	"
"	10 A. M.	29.95	73	"	"	"	12 M.	30.10	72	"	"
"	12 M.	29.90	74	"	"	"	6 P. M.	30.06	69	"	"
"	2 P. M.	29.96	76	"	"	Aug. 3.	6 A. M.	30.10	64	N.	"
"	6 P. M.	29.95	77	"	Fair.	"	10 A. M.	30.20	69	"	"
July 18.	6 A. M.	29.77	73	"	"	"	12 M.	30.14	73	"	"
"	10 A. M.	29.80	79	"	"	"	6 P. M.	30.16	72	N.W.	"
"	12 M.	29.80	81	"	"	Aug. 4.	6 A. M.	30.17	68	N. E.	"
"	2 P. M.	29.77	82	"	"	"	10 A. M.	30.18	68	"	Cloudy
"	6 P. M.	29.76	81	"	"	"	12 M.	30.15	69	"	"
July 19.	6 A. M.	29.80	77	S.	"	"	2 P. M.	30.15	71	"	"
"	10 A. M.	29.85	80	"	"	"	6 P. M.	30.12	69	"	"
"	12 M.	29.81	81	"	"	Aug. 5.	6 A. M.	30.12	66	E.	"
"	2 P. M.	29.78	83	"	"	"	10 A. M.	30.14	68	"	"
"	6 P. M.	29.80	83	"	"	"	12 M.	30.10	68	"	"
July 20.	6 A. M.	29.70	79	W.	"	"	2 P. M.	30.12	69	"	"
"	10 A. M.	29.75	78	"	"	"	6 P. M.	30.12	69	"	Rainy.
"	12 M.	29.80	79	"	"	Aug. 6.	6 A. M.	30.15	68	"	Cloudy
"	2 P. M.	29.82	80	"	"	"	10 A. M.	30.18	72	"	"
"	6 P. M.	29.96	78	"	"	"	12 M.	30.15	73	"	"
July 21.	6 A. M.	30.17	72	N.W.	"	"	2 P. M.	30.15	74	"	"
"	10 A. M.	30.18	72	"	"	"	6 P. M.	30.14	73	"	"
"	12 M.	30.18	74	"	"	Aug. 8.	6 A. M.	29.	71	"	"

Date. 1842.	Hour.	Barom	T.	Wind.	Weath.
Aug. 8.	12 M.	29.	72	E.	Cloudy.
Aug. 15.	6 A. M.	29.04	68	N. E.	"
"	10 A. M.	29.04	73	"	"
"	12 M.	29.93	76	"	"
"	2 P. M.	29.93	75	N.	"
"	6 P. M.	29.92	76	N. E.	"
Aug. 16.	10 A. M.	29.94	72	"	"
"	12 M.	29.90	74	"	"
"	2 P. M.	29.90	74	"	"
"	6 P. M.	29.90	74	E.	"
Aug. 17.	6 A. M.	29.90	70	"	"
"	10 A. M.	29.93	71	"	"
"	12 M.	29.90	72	"	"
"	2 P. M.	29.87	74	"	"
"	6 P. M.	29.87	74	"	"
Aug. 18.	6 A. M.	29.85	70	"	Rainy.
"	10 A. M.	29.88	72	"	Cloudy.
"	12 M.	29.82	74	"	"
"	2 P. M.	29.85	76	"	"
"	6 P. M.	29.80	77	"	Fair.
Aug. 19.	6 A. M.	29.85	74	S.	Cloudy.
"	10 A. M.	29.85	77	S.	"
"	2 P. M.	29.80	80	S.W.	Fair.
"	6 P. M.	29.80	79	"	"
Aug. 20.	6 A. M.	29.90	73	W.	"
"	10 A. M.	29.94	74	"	"
"	12 M.	29.90	75	"	"
"	2 P. M.	29.90	75	"	Cloudy.
"	6 P. M.	29.94	74	"	Fair.
Aug. 22.	6 A. M.	30.23	68	N.	"
"	10 A. M.	30.23	72	"	"
"	12 M.	30.24	74	"	"
"	2 P. M.	30.20	76	"	"
"	6 P. M.	30.20	74	"	"
Aug. 23.	6 A. M.	30.27	68	"	"
"	10 A. M.	30.31	72	"	"
"	2 P. M.	30.28	76	"	"
"	6 P. M.	30.25	75	"	"
Aug. 24.	6 A. M.	30.25	68	W.	"
"	10 A. M.	30.25	70	"	"
"	12 M.	30.23	74	"	"
"	2 P. M.	30.18	74	"	"
"	6 P. M.	30.15	73	"	"
Aug. 25.	6 A. M.	30.08	67	S.W.	"
"	10 A. M.	30.06	71	"	"
"	12 M.	30.05	73	"	"
"	2 P. M.	30.	73	"	Cloudy.
Aug. 26.	6 A. M.	29.95	70	S.	Rainy.
"	10 A. M.	29.95	72	"	Cloudy.
"	12 M.	29.93	74	"	"
Aug. 26.	2 P. M.	29.93	74	S.	Cloudy
"	6 P. M.	29.90	74	"	"
Aug. 27.	6 A. M.	29.90	73	S. E.	"
"	10 A. M.	29.90	74	"	"
"	12 M.	29.87	75	"	"
"	2 P. M.	29.83	77	"	"
Aug. 29.	6 A. M.	29.65	70	E.	Fair.
"	10 A. M.	29.67	75	N.W.	"
"	2 P. M.	29.67	76	"	"
"	6 P. M.	29.80	70	"	"
Aug. 30.	6 A. M.	29.95	67	"	"
"	10 A. M.	30.	72	"	"
"	12 M.	30.	72	"	"
"	2 P. M.	29.97	72	"	"
"	6 P. M.	30.	71	"	"
Aug. 31.	6 A. M.	30.14	60	"	"
"	10 A. M.	30.12	67	"	Cloudy
"	12 M.	30.13	67	"	"
"	2 P. M.	30.10	70	"	"
Sept. 1.	6 A. M.	30.08	68	S. E.	"
"	10 A. M.	30.08	73	"	Fair.
"	12 M.	30.05	73	"	"
"	2 P. M.	30.03	74	"	Cloudy
Sept. 2.	6 A. M.	29.95	70	S.W.	Fair.
"	10 A. M.	29.97	74	"	"
"	12 M.	29.95	77	"	"
"	2 P. M.	29.94	78	"	"
"	6 P. M.	29.91	74	"	Cloudy
Sept. 3.	6 A. M.	29.92	73	"	Fair.
"	10 A. M.	29.87	75	"	Cloudy
"	2 P. M.	29.82	74	"	"
Sept. 5.	10 A. M.	29.75	68	"	Rainy.
"	12 M.	29.70	69	"	"
"	2 P. M.	29.70	70	"	Cloudy
"	6 P. M.	29.72	72	"	Fair.
Sept. 6.	6 A. M.	29.95	67	N.	"
"	10 A. M.	30.	70	"	"
"	12 M.	30.	70	"	"
"	2 P. M.	29.97	70	"	"
Sept. 7.	6 A. M.	29.95	64	N.W.	"
"	10 A. M.	29.92	64	"	Cloudy
"	12 M.	29.85	66	"	"
"	2 P. M.	29.82	66	"	"
Sept. 8.	6 A. M.	29.98	64	"	Fair.
"	10 A. M.	29.97	67	"	"
"	12 M.	29.96	68	"	"
"	2 P. M.	29.95	67	"	"
"	6 P. M.	29.96	66	"	"
Sept. 9.	6 A. M.	29.90	63	E.	Rainy.
"	10 A. M.	29.90	63	"	"

Date. 1842.	Hour.	Barom	T.	Wind.	Weath.	Date. 1842.	Hour.	Barom	T.	Wind.	Weath.
Sept. 9.	12 M.	29.85		E.	Rainy.	Sept. 29.	2 P. M.	29.93	66	S.W.	Fair.
"	2 P. M.	29.87		"	"	Sept. 30.	6 A. M.	29.94	59	"	Cloudy
Sept. 10.	6 A. M.	29.97	62	N.	Fair.	Oct. 1.	6 A. M.	29.73	57	"	Fair.
Sept. 12.	6 A. M.	29.57	60	S.W.	"	"	10 A. M.	29.73		"	"
Sept. 13.	10 A. M.	29.47		"	Rainy.	"	2 P. M.	29.74		"	"
Sept. 14.	6 A. M.	29.90	64	N.W.	Fair.	Oct. 3.	6 A. M.	29.80	56	N.W.	"
"	12 M.	29.95	66	"	"	"	12 M.	29.73		"	"
"	2 P. M.	29.95	67	"	"	Oct. 4.	6 A. M.	29.78	58	"	"
"	6 P. M.	29.96	67	"	"	"	12 M.	29.85		"	"
Sept. 15.	6 A. M.	30.04	63		Rainy.	Oct. 5.	6 A. M.	29.95	57	"	"
"	10 A. M.	30.05		E.	"	"	12 M.	30.		"	"
"	12 M.	30.05		"	"	Oct. 6.	6 A. M.	30.16	53	"	"
"	2 P. M.	30.04		"	"	"	12 M.	30.17		"	"
Sept. 16.	10 A. M.	29.95		"	"	Oct. 7.	6 A. M.	30.11	53	"	"
"	12 M.	29.93		"	"	"	12 M.	30.05		"	"
Sept. 17.	6 A. M.	29.90	64	W.	Fair.	Oct. 8.	6 A. M.	29.86		S.W.	"
"	12 M.	29.87		"	"	Oct. 10.	7 A. M.	29.70	58	N.W.	"
"	2 P. M.	29.85		"	"	"	12 M.	29.77		"	"
Sept. 19.	6 A. M.	29.73	68	"	"	Oct. 11.	7 A. M.	29.72	52	"	"
"	12 M.	29.80		"	Cloudy.	Oct. 12.	7 A. M.	29.50	56	"	"
"	2 P. M.	29.77		"	"	Oct. 13.	7 A. M.	29.95	53	"	"
Sept. 20.	6 A. M.	29.93	60	N.W.	Fair.	Oct. 14.	7 A. M.	29.95	51	"	"
"	10 A. M.	29.97		"	"	Oct. 17.	7 A. M.	29.86	54	S.W.	"
"	12 M.	29.97		"	"	Oct. 18.	7 A. M.	29.97		N.W.	"
"	2 P. M.	29.95		"	"	Oct. 19.	7 A. M.	29.71		"	"
Sept. 21.	10 A. M.	29.72		"	Cloudy.	Oct. 20.	7 A. M.	29.95		"	Cloudy
"	12 M.	29.63		W.	"	Oct. 21.	7 A. M.	30.05		"	Fair.
"	2 P. M.	29.58		S.W.	Rainy.	Oct. 22.	7 A. M.	29.73		"	"
Sept. 22.	6 A. M.	29.63	58	N.W.	Fair.	Oct. 24.	7 A. M.	29.95		"	"
"	12 M.	29.68		"	Cloudy.	Oct. 25.	7 A. M.	29.77		S.	Rainy.
Sept. 23.	6 A. M.	29.80	53	"	Fair.	Oct. 26.	7 A. M.	29.73		N.W.	Fair.
"	12 M.	29.87		"	"	Oct. 27.	7 A. M.	29.90		"	"
Sept. 24.	6 A. M.	29.95	53	"	"	Oct. 28.	7 A. M.	30.27		"	"
"	12 M.	29.97		"	"	Oct. 29.	7 A. M.	30.15		"	Cloudy
Sept. 26.	6 A. M.	30.12	52	"	"	Oct. 31.	7 A. M.	30.27		S.E.	Fair.
"	12 M.	30.13		"	"	Nov. 1.	7 A. M.	30.05		"	"
Sept. 27.	6 A. M.	30.04	55	"	"	Nov. 2.	7 A. M.	30.10		N.W.	"
"	12 M.	30.		"	"	Nov. 3.	7 A. M.	30.25		"	"
Sept. 28.	6 A. M.	29.74	60	S.W.	Cloudy.	Nov. 4.	7 A. M.	30.15		"	"
Sept. 29.	6 A. M.	29.90	61	"	Fair.	Nov. 5.	7 A. M.	30.05		"	"
"	12 M.	29.93	64	"	"	Nov. 7.	7 A. M.	29.76		N.	Cloudy

TABLES FOR CALCULATING HEIGHTS BY THE BAROMETER.

The following Tables are those of M. Oltmanns, which are generally admitted as among the most convenient hitherto published. Being calculated for the metrical barometer, they were useless to persons employing that graduated according to English inches

and their decimal parts. To render them applicable to our barometers, a table (A) has been prefixed, in which the equivalent of every millimetre of the metrical barometer is given in English inches and the thousandth parts of inches.

To reduce the metres used in these tables into English feet, a table (F) is appended, where the number of English feet corresponding to any number of metres up to 10,000 will be immediately obtained.

Abstraction being made of table A prefixed, and table F appended, the march of operation is as follows:

Let h be the height of the barometer at the lower station expressed in millimetres; h' that of the higher station; T and T′ the temperature of the barometer at the different stations according to the centigrade thermometer; t and t' that of the air.

We search in table B for the number which corresponds to h; let us call it a: we likewise search in the same table for that which corresponds to h'; let this be named b: let us call c, the generally very small number which, in table C, faces T—T′; the approximate height will be $a—b—c$. (If T—T′ is negative, it should be written $a—b+c$.) In order to apply the correction necessary for the strata of air, it will suffice to multiply the thousandth part of the approximate height by the double sum $2\ (t+t')$ of the detached thermometers; the correction will be either positive or negative, according as $t+t'$ is itself either positive or negative.

The second and last correction, that for the latitude and the diminution of weight, is obtained by taking, in table D, the number which corresponds vertically to the latitude, and horizontally to the approximate height: this correction, which can never exceed 28 metres, is always added.

In those very rare cases where the lower station is itself considerably elevated above the sea, it will be necessary to apply a small correction to be found in table E.

In order to understand the calculation of a height by means of these tables, and those prefixed and appended, let us suppose that in latitude $= 44°$ we had, at the level of the sea, the barometer $=$ 30.040 English inches, temperature of the instrument $= 22°.5$ centigrade, and of the air $=22°$. At the top of a mountain, the barometer $=$ 26.575 English inches, temperature of the instrument $= 17°.5$, and of the air $=17°$.

In order to obtain the equivalents of the English inches in millimetres, search in table A; where the number of millimetres corresponding to 30.040 inches observed at the sea will be 763, and that of 26.575 observed on the mountain will be 675. Having obtained these equivalents the calculation proceeds:

	Mill.	Metres.	
Barometer at sea level, - - - - -	= 763	= 6128.0	Table B.
Barometer on the mountain, - - - - -	= 675	= 5206.1	
		975.9	
Difference of attached thermometers, - -	= 5°	= 7.4	Table C.
Apparent height, - - - - - - - -		968.5	
Double the sum of the detached thermometers multiplied by the thousandth part of 968.5. - -		75.5	
		1044.	
Correction for latitude, - - - - - - -		3.1	Table D.
Height of the mountain, - - - - - -		1047.1	
Height in English feet, - - - - -		3435	Table F.

When the height of the barometer, graduated according to English inches and their

parts, does not precisely correspond with a certain number of millimetres, and when great accuracy is required, it will be obvious, that instead of taking the next nearest number to it in the tables, as might otherwise be done, it will be necessary to calculate the difference.

TABLE A.

Inches	Mil.	Inches.	Mil.	Inches.	Mil.	Inches.	Mil.	Inches.	Mil.	Inches.	Mil.
14.560	370	16.378	416	18.189	462	20.000	508	21.812	554	23.622	600
.606	371	.417	417	.229	463	.040	509	.851	555	.662	601
.646	372	.457	418	.268	464	.079	510	.890	556	.701	602
.685	373	.496	419	.307	465	.118	511	.929	557	.741	603
.725	374	.536	420	.347	466	.158	512	.969	558	.780	604
.764	375	.575	421	.386	467	.197	513	22.008	559	.819	605
.803	376	.614	422	.425	468	.237	514	.048	560	.859	606
.843	377	.654	423	.465	469	.276	515	.087	561	.898	607
.882	378	.693	424	.504	470	.315	516	.126	562	.937	608
.921	379	.733	425	.543	471	.355	517	.166	563	.977	609
.961	380	.772	426	.583	472	.394	518	.205	564	24.016	610
15.000	381	.811	427	.622	473	.433	519	.244	565	.055	611
.040	382	.851	428	.662	474	.473	520	.284	566	.095	612
.079	383	.890	429	.701	475	.512	521	.323	567	.134	613
.118	384	.929	430	.740	476	.551	522	.363	568	.174	614
.156	385	.969	431	.780	477	.590	523	.402	569	.213	615
.197	386	17.008	432	.819	478	.630	524	.441	570	.252	616
.236	387	.047	433	.859	479	.670	525	.481	571	.292	617
.276	388	.087	434	.898	480	.709	526	.520	572	.331	618
.315	389	.126	435	.937	481	.748	527	.559	573	.370	619
.355	390	.166	436	.977	482	.788	528	.599	574	.410	620
.394	391	.205	437	19.016	483	.827	529	.638	575	.449	621
.433	392	.244	438	.055	484	.866	530	.678	576	.489	622
.473	393	.284	439	.095	485	.901	531	.717	577	.528	623
.512	394	.323	440	.134	486	.945	532	.756	578	.567	624
.551	395	.362	441	.174	487	.984	533	.796	579	.607	625
.591	396	.402	442	.213	488	21.025	534	.835	580	.646	626
.630	397	.441	443	.252	489	.063	535	.874	581	.685	627
.670	398	.481	444	.292	490	.102	536	.914	582	.725	628
.709	399	.520	445	.331	491	.142	537	.953	583	.764	629
.748	400	.559	446	.370	492	.181	538	.992	584	.804	630
.788	401	.599	447	.410	493	.220	539	23.032	585	.843	631
.827	402	.638	448	.449	494	.260	540	.071	586	.882	632
.866	403	.677	449	.488	495	.300	541	.111	587	.922	633
.906	404	.717	450	.528	496	.339	542	.150	588	.961	634
.945	405	.756	451	.567	497	.378	543	.189	589	25.000	635
.985	406	.795	452	.607	498	.418	544	.229	590	.040	636
16.024	407	.835	453	.646	499	.457	545	.268	591	.079	637
.063	408	.874	454	.685	500	.496	546	.307	592	.119	638
.102	409	.914	455	.725	501	.536	547	.347	593	.158	639
.142	410	.953	456	.764	502	.575	548	.386	594	.197	640
.181	411	.992	457	.803	503	.615	549	.426	595	.237	641
.221	412	18.032	458	.843	504	.654	550	.465	596	.276	642
.260	413	.071	459	.882	505	.693	551	.504	597	.315	643
.299	414	.110	460	.922	506	.733	552	.544	598	.355	644
.339	415	.150	461	.961	507	.772	553	.583	599	.394	645

TABLE A. (*continued.*)

Inches.	Mil.	Inches.	Mil.	Inches.	Mil.	Inches.	Mil.	Inches.	Mil.	Inches.	Mil.
25.433	646	26.378	670	27.324	694	28.268	718	29.213	742	30.158	766
.473	647	.418	671	.363	695	.308	719	.252	743	.197	767
.512	648	.457	672	.403	696	.347	720	.291	744	.237	768
.551	649	.496	673	.442	697	.386	721	.331	745	.276	769
.590	650	.536	674	.482	698	.426	722	.371	746	.316	770
.630	651	.575	675	.521	699	.465	723	.410	747	.355	771
.670	652	.615	676	.560	700	.504	724	.449	748	.394	772
.709	653	.654	677	.600	701	.544	725	.489	749	.433	773
.749	654	.693	678	.639	702	.583	726	.528	750	.473	774
.788	655	.733	679	.678	703	.622	727	.567	751	.512	775
.827	656	.772	680	.718	704	.662	728	.607	752	.552	776
.866	657	.811	681	.757	705	.701	729	.646	753	.591	777
.906	658	.851	682	.796	706	.741	730	.686	754	.630	778
.945	659	.891	683	.836	707	.780	731	.725	755	.670	779
.985	660	.931	684	.875	708	.819	732	.764	756	.709	780
26.024	661	.970	685	.915	709	.859	733	.804	757	.749	781
.063	662	27.010	686	.954	710	.898	734	.843	758	.788	782
.103	663	.049	687	.993	711	.937	735	.882	759	.827	783
.142	664	.089	688	28.032	712	.977	736	.922	760	.867	784
.182	665	.128	689	.071	713	29.016	737	.961	761	.906	785
.221	666	.167	690	.111	714	.056	738	30.000	762	.945	786
.260	667	.206	691	.150	715	.095	739	.040	763	.985	787
.300	668	.246	692	.189	716	.134	740	.079	764	31.024	788
.339	669	.285	693	.229	717	.174	741	.119	765	.064	789

TABLE B.

Mil.	Metres.	Mil.	Metres.	Mil.	Metres.	Mil.	Metres.	Mil.	Metres.	Mil.	Metres.
370	418.5	392	878.5	414	1313.3	436	1725.6	458	2117.6	480	2491.3
371	440.0	393	898.8	415	1332.5	437	1743.8	459	2135.0	481	2507.9
372	461.5	394	919.0	416	1351.7	438	1762.1	460	2152.3	482	2524.3
373	482.9	395	939.2	417	1370.8	439	1780.3	461	2169.6	483	2540.8
374	504.2	396	959.3	418	1389.9	440	1798.4	462	2186.9	484	2557.3
375	525.4	397	979.4	419	1408.9	441	1816.5	463	2204.1	485	2573.7
376	546.6	398	999.5	420	1427.9	442	1834.5	464	2221.3	486	2590.2
377	567.8	399	1019.5	421	1446.8	443	1852.5	465	2238.4	487	2506 6
378	588.9	400	1039.4	422	1465.7	444	1870.4	466	2255.5	488	2622.9
379	609.9	401	1059.3	423	1484.6	445	1888.3	467	2272.6	489	2639.2
380	630.9	402	1079.1	424	1503.4	446	1906.2	468	2280.6	490	2655.4
381	651.8	403	1098.9	425	1522.2	447	1924.0	469	2306.6	491	2671.6
382	672.7	404	1118.6	426	1540.8	448	1941.8	470	2323.6	492	2687.9
383	693.5	405	1138.3	427	1559.5	449	1959.6	471	2340.5	493	2704.1
384	714.3	406	1157.9	428	1578.2	450	1977.3	472	2357.4	494	2720.2
385	735.0	407	1177.5	429	1596.8	451	1994.9	473	2374.2	495	2736.3
386	755.6	408	1197.1	430	1615.3	452	2012.6	474	2391.1	496	2752.3
387	776.2	409	1216.6	431	1633.8	453	2030.2	475	2407.9	497	2768.3
388	796.8	410	1236.0	432	1652.2	454	2047.8	476	2424.6	498	2784.4
389	817.3	411	1255.4	433	1670.6	455	2065.3	477	2441.3	499	2800.4
390	837.8	412	1274.8	434	1689.0	456	2082.8	478	2458.0	500	2816.3
391	858.2	413	1294.1	435	1707.3	457	2100.2	479	2474.6	501	2832.2

TABLE B. (*continued.*)

Mil.	Metres.	Mil.	Metres.	Mil.	Metres.	Mil.	Metres.	Mil.	Metres.	Mil.	Metres.
502	2848.1	551	3589.8	599	4254.9	647	4868.7	695	5438.7	743	5970.4
503	2864.0	552	3604.2	600	4268.2	648	4881.0	696	5450.1	744	5981.2
504	2879.8	553	3618.6	601	4281.4	649	4893.3	697	5461.5	745	5991.9
505	2895.6	554	3633.0	602	4294.7	650	4905.6	698	5472.9	746	6002.5
506	2911.3	555	3647.4	603	4307.9	651	4917.8	699	5484.3	747	6013.2
507	2927.0	556	3661.7	604	4321.1	652	4930.0	700	5495.7	748	6023.8
508	2942.7	557	3676.0	605	4334.3	653	4942.2	701	5507.1	749	6034.4
509	2958.4	558	3690.3	606	4347.4	654	4954.4	702	5518.4	750	6045.1
510	2974.0	559	3704.6	607	4360.5	655	4966.6	703	5529.8	751	6055.7
511	2989.6	560	3718.8	608	4373.7	656	4978.7	704	5541.1	752	6066.3
512	3005.2	561	3733.0	609	4386.7	657	4990.9	705	5552.4	753	6076.9
513	3020.7	562	3747.2	610	4399.8	658	5003.0	706	5563.7	754	6087.5
514	3036.2	563	3761.3	611	4412.8	659	5015.1	707	5575.0	755	6098.0
515	3051.7	564	3775.4	612	4425.9	660	5027.2	708	5586.2	756	6108.6
516	3067.2	565	3789.5	613	4438.9	661	5039.2	709	5597.5	757	6119.1
517	3082.6	566	3803.6	614	4451.9	662	5051.2	710	5608.7	758	6129.6
518	3097.9	567	3817.7	615	4464.8	663	5063.3	711	5619.6	759	6140.1
519	3113.3	568	3831.7	616	4477.7	664	5075.3	712	5631.1	760	6150.6
520	3128.6	569	3845.7	617	4490.7	665	5087.2	713	5642.2	761	6161.1
521	3143.9	570	3859.7	618	4503.6	666	5099.2	714	5653.4	762	6171.5
522	3159.2	571	3873.7	619	4516.4	667	5111.2	715	5664.6	763	6182.0
523	3174.4	572	3887.6	620	4529.3	668	5123.1	716	5675.7	764	6192.4
524	3189.7	573	3901.5	621	4542.1	669	5135.0	717	5686.8	765	6202.8
525	3204.9	574	3915.4	622	4554.9	670	5146.9	718	5697.9	766	6213.2
526	3220.0	575	3929.3	623	4567.7	671	5158.8	719	5709.0	767	6223.6
527	3235.1	576	3943.1	624	4580.5	672	5170.6	720	5720.1	768	6234.0
528	3250.2	577	3956.9	625	4593.2	673	5182.5	721	5731.1	769	6244.4
529	3265.3	578	3970.7	626	4606.0	674	5194.3	722	5742.1	770	6254.7
530	3280.3	579	3984.5	627	4618.7	675	5206.1	723	5753.1	771	6265.0
531	3295.3	580	3998.2	628	4631.4	676	5217.9	724	5764.2	772	6275.4
532	3310.3	581	4011.1	629	4644.0	677	5229.7	725	5775.1	773	6285.7
533	3325.3	582	4025.6	630	4656.7	678	5241.4	726	5786.1	774	6296.0
534	3340.2	583	4039.3	631	4669.3	679	5253.2	727	5797.1	775	6306.2
535	3355.1	584	4052.9	632	4682.0	680	5264.9	728	5808.0	776	6316.5
536	3370.0	585	4066.6	633	4694.5	681	5276.6	729	5819.0	777	6326.7
537	3384.8	586	4080.2	634	4707.1	682	5288.3	730	5829.9	778	6337.0
538	3399.6	587	4093.8	635	4719.7	683	5300.0	731	5840.8	779	6347.2
539	3414.4	588	4107.3	636	4732.2	684	5311.6	732	5851.7	780	6357.4
540	3429.2	589	4120.8	637	4744.7	685	5323.2	733	5862.5	781	6367.6
541	3443.9	590	4134.3	638	4757.2	686	5334.8	734	5873.4	782	6377.8
542	3458.6	591	4147.8	639	4769.7	687	5346.4	735	5884.2	783	6388.0
543	3473.3	592	4161.3	640	4782.1	688	5358.0	736	5895.9	784	6398.2
544	3487.9	593	4174.7	641	4794.6	689	5369.6	737	5905.1	785	6408.3
545	3502.5	594	4188.1	642	4807.0	690	5381.1	738	5916.7	786	6418.5
546	3517.2	595	4201.5	643	4819.4	691	5392.7	739	5927.5	787	6428.6
547	3531.8	596	4214.9	644	4831.7	692	5404.2	740	5938.2	788	6438.7
548	3546.3	597	4228.2	645	4844.1	693	5415.6	741	5949.0	789	6448.8
549	3560.8	598	4241.6	646	4856.4	694	5427.2	742	5959.7	790	6458.9
550	3575.3										

TABLE C.

Deg.	Metre.	Deg.	Metre.	Deg.	Metre.	Deg.	Metre.	Deg.	Metre.
0.2	0.3	4.2	6.2	8.2	12.1	12.2	17.9	16.2	23.8
0.4	0.6	4.4	6.5	8.4	12.4	12.4	18.2	16.4	24.1
0.6	0.9	4.6	6.8	8.6	12.6	12.6	18.5	16.6	24.4
0.8	1.2	4.8	7.1	8.8	12.9	12.8	18.8	16.8	24.7
1.0	1.5	5.0	7.4	9.0	13.2	13.0	19.1	17.0	25.0
1.2	1.8	5.2	7.6	9.2	13.5	13.2	19.4	17.2	25.3
1.4	2.1	5.4	7.9	9.4	13.8	13.4	19.7	17.4	25.6
1.6	2.3	5.6	8.2	9.6	14.1	13.6	20.0	17.6	25.9
1.8	2.6	5.8	8.5	9.8	14.4	13.8	20.3	17.8	26.2
2.0	2.9	6.0	8.8	10.0	14.7	14.0	20.6	18.0	26.5
2.2	3.2	6.2	9.1	10.2	15.0	14.2	20.9	18.2	26.8
2.4	3.5	6.4	9.4	10.4	15.3	14.4	21.2	18.4	27.1
2.6	3.8	6.6	9.7	10.6	15.6	14.6	21.5	18.6	27.4
2.8	4.1	6.8	10.0	10.8	15.9	14.8	21.8	18.8	27.7
3.0	4.4	7.0	10.3	11.0	16.2	15.0	22.1	19.0	28.0
3.2	4.7	7.2	10.6	11.2	16.5	15.2	22.4	19.2	28.2
3.4	5.0	7.4	10.9	11.4	16.8	15.4	22.7	19.4	28.5
3.6	5.3	7.6	11.2	11.6	17.1	15.6	22.9	19.6	28.8
3.8	5.6	7.8	11.5	11.8	17.4	15.8	23.2	19.8	29.1
4.0	5.9	8.0	11.8	12.0	17.6	16.0	23.5		

TABLE D.

App. Heat.	0°	5°	10°	15°	20°	25°	App. Heat.	0°	5°	10°	15°	20°	25°
	m.	m.	m.	m.	m.	m.		m.	m.	m.	m.	m.	m.
200	1.2	1.2	1.2	1.0	1.0	1.0	3200	19.1	18.9	18.7	18.0	17.0	15.7
400	2.4	2.4	2.4	2.2	2.0	2.0	3400	20.5	20.3	20.1	19.3	18.4	16.9
600	3.4	3.4	3.4	3.2	3.0	2.8	3600	21.8	21.7	21.4	20.4	19.6	18.0
800	4.5	4.5	4.5	4.3	4.1	3.8	3800	23.1	22.9	22.6	21.6	20.6	19.1
1000	5.7	5.7	5.7	5.3	5.1	4.8	4000	24.6	24.4	24.0	22.9	21.9	20.3
1200	7.0	7.0	6.8	6.4	6.0	5.8	4200	25.9	25.7	25.3	24.3	23.0	21.6
1400	8.2	8.2	8.0	7.6	7.1	6.7	4400	27.5	27.3	26.8	25.8	24.3	23.0
1600	9.2	9.2	9.0	8.8	8.2	7.6	4600	28.9	28.7	28.2	27.1	25.6	24.3
1800	10.4	10.4	10.2	9.8	9.4	8.6	4800	30.4	30.2	29.6	28.4	27.0	25.5
2000	11.6	11.5	11.3	11.0	10.4	9.6	5000	31.8	31.6	30.9	29.8	28.4	26.7
2200	12.8	12.6	12.6	12.1	11.4	10.6	5200	33.0	32.8	32.1	31.0	29.7	28.0
2400	14.0	14.0	13.8	13.3	12.5	11.6	5400	34.3	34.1	33.5	32.4	30.8	29.2
2600	15.2	15.2	15.0	14.4	13.6	12.6	5600	35.7	35.5	34.8	33.7	32.1	30.2
2800	16.6	16.5	16.4	15.6	14.8	13.6	5800	37.1	36.9	36.1	35.0	33.2	31.3
3000	17.9	17.7	17.6	16.8	15.8	14.6	6000	38.5	38.3	37.5	36.3	34.3	32.3

TABLE D. (*continued.*)

App. Height	30°	35°	40°	45°	50°	55°	App. Height	30°	35°	40°	45°	50°	55°
	m.	m.	m.	m.	m.	m.		m.	m.	m.	m.	m.	m.
200	0.8	0.8	0.6	0.6	0.6	0.4	3200	14.6	13.1	11.5	10.1	8.6	7.0
400	1.8	1.7	1.4	1.2	1.0	0.8	3400	15.7	14.1	12.4	10.9	9.2	7.7
600	2.6	2.4	2.0	1.8	1.6	1.2	3600	16.7	15.0	13.4	11.6	9.8	8.2
800	3.5	3.1	2.8	2.4	2.0	1.7	3800	17.7	15.9	14.3	12.4	10.5	8.7
1000	4.3	3.8	3.4	3.1	2.6	2.2	4000	18.7	17.0	15.1	13.1	11.2	9.4
1200	5.1	4.6	4.2	3.6	3.1	2.6	4200	19.9	18.0	15.9	14.0	12.0	10.1
1400	6.1	5.4	4.8	4.2	3.6	3.0	4400	21.1	19.1	16.9	15.0	12.9	10.8
1600	7.0	6.2	5.6	4.8	4.1	3.4	4600	22.3	20.3	18.0	15.9	13.6	11.5
1800	8.0	7.0	6.3	5.4	4.6	3.8	4800	23.4	21.3	19.0	16.7	14.3	12.1
2000	8.8	7.8	7.0	6.0	5.1	4.2	5000	24.6	22.3	19.9	17.4	15.0	12.7
2200	9.7	8.6	7.6	6.6	5.6	4.6	5200	25.7	23.3	20.8	18.2	15.7	13.3
2400	10.6	9.4	8.4	7.2	6.1	5.1	5400	26.7	24.3	21.7	19.1	16.4	13.9
2600	11.6	10.5	9.2	8.0	6.8	5.6	5600	27.8	25.3	22.6	19.9	17.2	14.5
2800	12.6	11.4	10.0	8.8	7.4	6.2	5800	28.9	26.3	23.6	20.7	17.8	15.1
3000	13.6	12.2	10·8	9.4	8.0	6.6	6000	30.0	27.3	24.6	21.5	18.5	15.7

TABLE E.

h	Metres.	*h*	Metres.
400	1.71	600	0.63
450	1.39	650	0.42
500	1.11	700	0.22
550	0.86	750	0.03

Let, for example, the height of the barometer at the lower station be=600 millimetres; the difference of level=1500 metres, we have 1000:0.63=1500:0.95, and the difference of the level corrected=1500.9 metres. This correction is always added.

TABLE F.

Reduction of Metres into English Feet and Inches.

Metres.	Feet.	Inches.	Metres.	Feet.	Inches.	Metres.	Feet.	Inches.
1	3	3.370	50	164	0.514	900	2952	9.261
2	6	6.740	60	196	10.217	1000	3280	10.290
3	9	10.111	70	229	7.920	2000	6561	8.58
4	13	1.481	80	262	5.623	3000	9842	6.87
5	16	4.851	90	295	3.326	4000	13123	5.16
6	19	8.222	100	328	1.029	5000	16404	3.45
7	22	11.592	200	656	2.058	6000	19685	1.74
8	26	2.963	300	984	3.087	7000	22966	0.03
9	29	6.333	400	1312	4.116	8000	26246	10.32
10	32	9.702	500	1640	5.145	9000	29527	8.61
20	65	7.405	600	1968	6.174	10000	32808	6.90
30	98	5.108	700	2296	7.203			
40	131	2.811	800	2624	8.232			

TABLE F. (*continued.*)

Reduction of Decimetres, Centimetres and Millimetres, to English Inches.

Dec.	Inches.	Cent.	Inches.	Milli.	Inches.
1	3.937	1	0.393	1	0.039
2	7.874	2	0.787	2	0.078
3	11.811	3	1.181	3	0.118
4	15.748	4	1.574	4	0.157
5	19.685	5	1.968	5	0.196
6	23.622	6	2.362	6	0.236
7	27.559	7	2.755	7	0.275
8	31.496	8	3.149	8	0.314
9	35.433	9	3.543	9	0.354
10	39.370	10	3.937	10	0.393

G. *Comparison of English and French Measures.*

(From Baily's Astronomical Tables.)

	Eng. Inches.		Fr. Metres.
French Metre, -	= 39.37079	French Toise, -	= 1.949036
" Toise, -	= 76.739400	" Foot, -	= 0.324839
" Foot, -	= 12.789900	" Inch, -	= 0.027070
" Inch, -	= 1.065825	English Foot, -	= 0.304794
" Line, -	= 0.088819	" Inch, -	= 0.025399

Constant Logarithms (always additive) for converting

French Toises into Metres,	0.2898200	French Feet into English Feet,	0.0276860
" Feet into Metres,	9.5116687	" Met. " "	0.5159929
" T. into English Feet,	0.8058372	Millimetres into English Inches,	8.5951741

Oltman's tables for Barometrical calculations, which are recommended by Gay Lussac as the most convenient, were originally published in the French *Annuaire*, by the Bureau des Longitudes. The table (A) for reducing English inches to French millimetres is extracted from H. T. Dela Beche's Geol. Manual. The degrees in table (C) are of the centigrade scale. To reduce the degrees of Farenheit's thermometer to the centigrade, multiply the degrees Farh. by 9, divide by 5 and add 32°. Some of the heights given in this Report, were calculated by means of the above tables, but I have generally preferred the method by logarithms, using the corrections given in Howlet's tables, computed from F. Baily's formula. I find this method more exact, and have therefore calculated the heights of nearly all the mountains we have measured in New Hampshire, by means of them. The printing having advanced so far as to preclude their insertion in the proper place, I have been obliged to omit these tables in this Report, and must refer the reader who may be desirous of consulting them, to page 254 of Major Basil Jackson's Military Surveying: London, 1838. By means of those tables and Callet's Logarithms, the heights of any places where we have made observations, may be readily calculated. A close approximation may be obtained by Oltman's tables.

APPENDIX,

TO AGRICULTURAL GEOLOGY AND CHEMISTRY.

(A)

The following is an extract from a Report on the organic matters of soils, which was prepared in accordance with a resolve of the American Association of Geologists, at their meeting in Philadelphia, and was read at their meeting in Albany in 1843.

It embodies some of the principles of Agricultural Chemistry, and may be of interest to the agricultural community. The society not publishing a volume at the close of their last meetings, this report is given to the public as an Appendix to my Agricultural researches in New Hampshire.

Extract from a Report on the Organic Matters of Soils, &c.

In treating of the chemistry of vegetables, and on the mode of action of the air and the soil on them, I shall lay down the following principles, which are regarded as sufficiently well established by experiments and observation:

1st. Plants derive their nourishment from the air, water and the soil;

2d. The principles which they take up are absorbed in a liquid or gaseous state, or, more properly, they are taken up in both of those conditions;

3d. They are absorbed in part by the rootlets, and in part by the foliage and the green bark of the stem.

The matters taken up by the rootlets are absorbed through membranes of the roots, or by spongeoles by *endosmosis*, the contained sap in the roots being denser than the weak solutions of organic and saline matters which exist in the soil. It appears, from numerous experiments, that any soluble matter in the soil, which is subject to the laws of endosmose, may enter the roots of plants; and, hence, they cannot be said strictly to have any power of choice as to the substances which they absorb, for even poisons readily enter the spongeoles and sap vessels of living plants, and destroy their vitality. *Exosmosis* probably takes place from the rootlets of plants, but not to the extent that was formerly supposed by Macaire Princeps and others. This opinion appears to be supported by researches lately made in France.

By the power of endosmomic action, through membranous diaphragms and cellular tissue, the sap is raised to the tops of the loftiest trees, which could not be effected by capillary attraction, to which it was formerly attributed. By the researches of Dutrochet it was ascertained that the sap ascends in a grape vine by a *vis a tergo*, capable of raising a column of mercury to more than 28 inches in height. This force has been observed by myself and others, when a piece of sheet India Rubber was tied over the freshly cut extremity of a grape vine in the spring, the India Rubber being forced out into a globular bag by the power of the ascending sap.

It is well known, also, that the ascending sap of the maple tree is forced through the pores of a wooden plug, which is driven into the tap hole in the tree.

The above considerations will show some of the dynamics of vegetation, and may enable us to conceive of the mode in which the soluble matters enter the circulation of plants. May they not also cast some light on the kinds and the density of liquid manures most favorable to vegetation? In the experiments on endosmose, it appeared that electrical action was the principal agency employed in the process of absorption through membranes. May not the electrical condition of the soil and of its fluids also play an important part in the processes of endosmosis by living plants? Are the soil and the plant in opposite electrical states? What is the influence of acid compared with an alkaline and a neutral mould? These questions I am, by no means, prepared to answer, but suggest them for consideration and for experimental research. But little has yet been done towards the investigation of the chemical relations of the soil and the plants which grow upon it.

It has been well proved that plants absorb carbonic acid gas, by the foliage, during the action of the sun's rays upon them, and that the carbon is retained in the plant, while the oxygen is exhaled. Thus Dumas regards plants as organs of *reduction*, while animals perform the function of *combustion* of carbon. It appears from his and other researches, that during this reduction of carbon from carbonic acid, by the foliage of plants, most of the chemical rays of light are absorbed; and this is illustrated by the want of power in the light reflected from green leaves, to impress their image on the sensitive coat of iodide of silver of the Daguerreotype plate.

It was formerly thought that plants produced nearly as much carbonic acid in the night, as they gave out of oxygen during the day, but exact experiments have proved this to be an error; for a mixture of carbonic acid and air is entirely deprived of its carbonic acid, when a plant is allowed to grow in it. Dumas is of opinion, which he substantiates by the researches of Boucherie, that, in darkness, plants do not *produce*, but merely *give passage* to *carbonic* acid from the soil, the gas not being decomposed when the action of light is withdrawn. When the trunk of a tree was cut off, Boucherie observed that carbonic acid gas was disengaged from the open sap vessels. This gas he supposes to have been absorbed from the soil.*

Oxygen gas of the atmosphere, in some stages of the growth of plants, is absorbed by them; but the proportion taken up is very trifling, when compared with that which they exhale. Oxygen indirectly acts as a source of fertility in the soil, by converting the various organic substances into soluble or gaseous matters, and forming with them those compounds which go to the nourishment of vegetation.

Oxygen also acts on the mineral ingredients of soils, converting protoxides of certain metals into peroxides, and sulphurets into sulphates. In a calcareous soil, sulphuret of iron may prove an indirect fertilizer. The sulphuret being oxidated by the air and by water, is converted into a sulphate, which, in its turn, acts upon the carbonate of lime, disengaging its carbonic acid, which goes to supply both the roots and foliage of plants; while sulphate of lime, a valuable saline manure, results, and the oxide of iron is perfectly harmless. The above remarks are illustrated by the fertilizing action of pyritiferous marls, and also by the use of pyritiferous lignite as a manure, in Belgium.

Nitrogen has not yet been proved to act directly on growing plants, either by the foliage or rootlets; yet it is certain that, *indirectly*, it is one of the most active ingredients in the vegetable economy, and it is well known that the value of an organic manure is directly proportional to the quantity of nitrogen which it contains.

In what form does this element enter into plants? This question has been satisfactorily answered by modern researches; and it has been ascertained that it is absorbed by the

*In my experiments on grape vines, no gas escaped through the column of sap in the glass tube; but on placing the sap under the bell of an air pump, and exhausting the air, bubbles of gas escaped from the sap. Was this carbonic acid, or atmospheric air? The experiment should be repeated to decide this question.

rootlets in two different states: 1st, in combination with oxygen and a base, or as nitrates; 2dly, as ammonia, which is composed, according to Dumas, of—

		At.
Nitrogen, - - - - - -	0.9720	=14.02
Hydrogen, - - - - - -	0.2079	= 3.
or 3 atoms hydrogen+1 atom nitrogen,	1.1799	

Nitric acid is formed in small quantities by the action of electricity in the atmosphere during thunder storms, the nitrogen and oxygen combining only where a flash of lightning passes. This we can prove, in a small way, by experiment. Gay Lussac long since detected nitric acid in rain water after thunder storms.

In the state of ammonia, nitrogen appears to have the most powerful influence on vegetation. This alkali is produced by the decomposition of animal matters in the soil, and also by the action of certain metallic oxides on air and water. It is also exhaled abundantly from the volcanoes of Europe, mostly in the states of muriate of ammonia and sulphate of ammonia. These salts are decomposed by calcareous soils, and carbonate of ammonia is formed, which is a powerful fertilizer. May not this fact serve, in part, to explain the fertility of the soil on and around Mt. Vesuvius?

Carbonate of ammonia is contained in the atmosphere, and arises from the decay of animal matters on the surface of the earth, and also from the combustion of wood and coal. It appears from very recent researches in England that it is exhaled from the lungs of men, but the experiments require a careful repetition before the result can be considered as satisfactorily proved; for the ammonia may have arisen from decaying teeth, a minute quantity only of the ammoniacal salt having been obtained.

The action of carbonate of ammonia on vegetation was made a subject of experiment by Prof. Le Coq, of Clermont Ferrand, in France, who published a prize essay on saline manures in 1831. He found that salt to be the most active of any tried; but he supposed that it would prove too costly for general use. I have repeated his experiments with the most satisfactory results; and have, for several years, been engaged in the investigation of its mode of action, and on the most economical modes of applying it to the soil.

By my experiments it was satisfactorily ascertained that carbonate of ammonia, when used in the proportion of 10 grains to 1 gallon of water, hastened the growth of every plant on which it was tried. Comparative experiments proved that it augmented the growth of Zea Mays, (Indian corn,) the weight of the plants being 5, when the corn was not treated with the carbonate of ammonia, and 8, when the ammonia was used. The solution was applied in small quantities at a time, and at the same time an equal quantity of rain water was sprinkled around the other corn, with which the experiment was compared. Applied to geraniums, rose bushes and to many other plants raised in pots, the carbonate of ammonia produced an increased and dark green foliage; but when too liberal a supply was used, the flowers were singularly affected, their petioles being short, and the petals of the flowers small, and sometimes changed in color. On the geranium a close and compact clump of flowers was produced. This experiment shows that carbonate of ammonia should be used very sparingly, and ought to be applied to the young plants, while they are forming their foliage, and not when inflorescence is about to take place. It also indicates its value as a manure on grass meadows, when it is an object to augment the foliage. In too large quantity, carbonate of ammonia produces the effect of a, so called, "too hot manure," the plants drooping and wilting as if they had been injured by a drought and the sun's heat.

From my researches into the nature of the organic matters of soils, and the action of composts, it would appear that carbonate of ammonia has a powerful agency in dissolving vegetable mould, and in forming with it a valuable manure. It also decomposes the insoluble compounds of the organic acids with earthy bases, and the organic matter is rendered available to the plant, while, in many cases, the resulting carbonate of the base is also directly or indirectly a manure.

Sulphate of ammonia is a fertilizing salt, but its mode of action is yet unknown. From the remarkable stimulating properties of gypsum, it was supposed that, since it is a sparingly soluble salt, it must undergo a chemical decomposition by the agency of carbonate of ammonia of rain water, sulphate of ammonia being formed. This fact was supposed to explain the action of gypsum, but since it does not act alike on all soils, and is inert on the sea coast, the explanation does not seem to be sufficient. The first recorded exact researches on the action of sulphate of ammonia are those of Prof. Le Coq, and he ascertained that on grass lands in Clermont 3 ounces of sulphate of ammonia were equivalent to 2 ounces of the carbonate. This would seem to prove that there is no advantage in converting carbonate of ammonia into the sulphate.

Organic Matters of Soils.

When any organized matter is exposed, after death, to the influence of air and water, it undergoes certain chemical changes, which have been called fermentation, putrefaction and eremacausis, or slow combustion.

During the process of fermentation of vegetable matters, starch becomes converted into sugar, alcohol and acetic acid. If other matters are present, very different changes take place also. Thus starch may be converted, by the action of diastase, into dextrine and sugar, or it may pass directly into the acetous fermentation. During the saccharine fermentation, carbonic acid is largely disengaged; while, during the acetous, oxygen is absorbed from the air.

Subsequent to this fermentation, still more complicated changes take place in vegetable matters, and they undergo an alteration, in which the fibrous and cellular matter is converted into a dark brown or black mass, called vegetable mould, or humus, which will be shown presently to be a mixed compound.

The conversion of wood and vegetable tissues, generally, into mould, takes place more perfectly when the vegetable matter is buried in moist soil.

In general, vegetable matters form acids, and the acids produced, combine with the alkalies, earths and oxides of metals, which they meet with in the soil. Some of the resulting salts are very soluble, while others are either insoluble, or but sparingly soluble in water.

Animal matters, when they decay, undergo a more rapid putrefaction, and the first product is ammonia. This gas is readily separated from the putrescent matter by the action of hydrate of lime. When the putrefaction or disorganization of animal matter is completed, a black mould is formed, which consists of organic acids, united with ammonia, and the salts which existed in the animal matter, are either converted into other salts, or they remain undecomposed, according to the play of affinities in each case.

Owing to the formation of ammonia by decomposing animal matter, it is found advantageous to mix animal manures with all vegetable substances in forming composts; and, since peat posseses antisceptic properties, it is proper in the spring season to mix hydrate of lime with the compost, in order to complete the decomposition. By this operation the ammoniacal gas is set free and penetrates every part of the compost heap, and if due care is taken to cover the heap with peat, or with a layer of gypsum, no ammonia will be lost.

Having explained, in some measure, the changes which organic matters undergo while decomposing, I would next give some account of the acids which ultimately result from the process. Formerly, the organic matter of mould was called ulmine and ulmic acid, from its resemblance to the substance exuded by disease in the elm tree.

Subsequently, Berzelius examined this matter, and divided ulmine into three distinct substances, which he called geine and geic acid, and apothème. (See *Traite Elementaire de Chemie, T. V.*, page 549, and *T. VI.*, page 573.) Lately that distinguished chemist has abandoned the names geine, geic acid and apothème, and has given new names to the

substances of which his old geine was found to be composed. (See *T. VIII.*, page 386, *Lehrbuch der Chemie, von. J. J. Berzelius, Dresden and Leipzig*, 1839.)

A writer in the American Journal of Science maintained, after I had assured the public of the contrary, that Berzelius had not abandoned the terms geine and geic acid. This error he was led into by a bookseller's trick of giving him an *old edition* with a *new title page*, viz.; the pretended new translation published at Bruxelles, 1840.

In the new edition, printed in German, under the superintendence of Wohler, the reader will find the words geine and geic acid occur but *once*, when they are fully *abandoned* as improper.

"Ich habe mich vor einiger Zeit dafür des Namens *Geïn* und *Geïnsäure* von γη Erde bedient, aber ich ziehe den Namen *Humin* vor, da er in jeder Rücksicht von einer passenderen Herleitung ist." (*P.* 386 *Lehrbuch der Chemie, von J. J. Berzelius, Achter Band—Leipsig*, 1839.)

The authority of Berzelius being universally regarded as the highest in chemical science, I think I am justified in discarding the term geine, which has recently been adopted by Dr. Dana and Prof. Hitchcock, and rendered conspicuous in the Final Report on the Geological Survey of Massachusetts. Berzelius, who first gave the organic matters of soil this name, having abandoned it, and having discovered crenic and apocrenic acids in decomposed vegetable matter, or mould, suggested, by his researches, their probable existence in soils generally. This I proved to be the case by analyses of many soils and subsoils obtained from every quarter of the globe. (See Report on the Geological and Agricultural Survey of Rhode Island, 1840.)

When I had completed my labors, and proved that there was no such proximate principle as geine, and had separated four new matters, which were called 1st, 2d, 3d and 4th extracts provisionally, the new edition of Berzelius' Chemistry, translated by Wohler, printed sheet by sheet from the German, was imported by one of my pupils, and in the 8th volume of that work, I found the new substances described and named. From the analysis of the Porla water, I had satisfied myself that Berzelius had substituted the terms crenic and apocrenic acids for geine; but no account had then been given of the pure humic acid, extract of humus and coal of humus, nor had the compound nature of extract of humus been ascertained before my researches were made.

Humus or mould is now found to consist of the following acids, united to various bases. They were discovered and named by Berzelius and Hermann:

1. Crenic acid;
2. Apocrenic acid;
3. Humic acid;
4. Humin;
5. Coal of humus;*
6. Extract of humus.

Crenic acid exists most abundantly in the subsoil from which it is in part separated by water or alcohol, or still better, by a weak solution of carbonate of ammonia, which decomposes the crenates of lime, alumina and iron, and takes up their crenic acid. After precipitating the apocrenic acid from this solution, which is done by rendering it slightly acid by acetic acid, and adding a solution of acetate of copper so long as a brown precipitate falls, we separate the crenic acid by rendering the solution slightly alkaline by carbonate of ammonia, when acetate of copper will give a greenish white precipitate of crenate of copper. This is collected, washed and decomposed by mixing it, while still moist, with pure water, and passing sulph-hydric acid gas through it, until all the copper is thrown down; then evaporate the filtered solution to dryness, and there will be obtained a honey yellow matter, which is crenic acid mixed sometimes with a little phosphoric acid, from which it is easily separated by lime water, which forms an insoluble phosphate of lime, while the crenate of lime is soluble in water.

* Probably altered humin or humic acids, for it is not obtained when the operation of evaporation is conducted *in vacuo* without heat.

Crenic acid, as I ascertained, exists in soils and peat from various localities. It is universally present in the soils of every quarter of the globe. Crenic acid is composed, by weight, of C. 14.24, H. 7.69, N. 7.50, Ox. 44.57, or C. 7, H. 16, O. 6, N. 1, atomically.

Apocrenic acid is distinguished by its forming dark brown salts with binacetate of copper. It is most abundant in the black mould of the surface, and especially in long cultivated soils. It may be separated from its copper salt by the action of sulph-hydric acid gas.

It is a very highly nitrogenized substance, and is composed of—

Carbon,	62.57	or 14.	Atoms.	
Hydrogen,	4.80	" 14.	"	
Nitrogen,	15.00	" 3.	"	
Oxygen,	17.63	" 3.	"	(*Hermann.*)

This acid is formed by long exposure of crenate of ammonia to atmospheric influence. It is formed by exposure of peat to the action of ammoniacal manures in presence of atmospheric air. Humic, glucic and apoglucic acids are readily converted into it by catalytic action.

The carbonate of ammonia, which is washed out from the air by rain, is fixed by mould in the state of soluble apocrenate of ammonia, which is a much better manure than the sulphate.

Humic Acid. After separating the apocrenic and crenic acids from the solution in carbonate of ammonia, we free the solution remaining from copper, by passing sulph-hydric acid gas through it, so long as it gives a precipitate; then filter and obtain a brownish yellow solution, which contains humic acid and extract of humus. Boil the solution until freed from sulph-hydric acid, or evaporate to near dryness, and re-dissolve in water. Add now a solution of sub-acetate of lead, and a greyish precipitate of the humate of lead is thrown down. Collect this on a filter, wash it and then decompose it by sulph-hydric acid gas; filter, evaporate *in vacuo* to dryness, and obtain humic acid.

It is composed of C. 30, H. 30, O. 15.—*Sprengel Malaguti;*—or according to Mulder, of C. 40, H. 26, O. 12.

It forms soluble salts with lime, and with all the alkalies. It is not precipitated by salts of copper. It forms with persalts of iron humate of the peroxide, which is of a yellow color. It is this salt, chiefly, which gives the yellow color to subsoils.

After clearing from lead, the solution from which the humate of lead had been thrown down, we evaporate to dryness *in vacuo*, and obtain a brown extract, which is called extract of humus. This is a highly nitrogenized compound, which, when treated with proto-nitrate of mercury and nitrate of silver, yields two different salts, that have not yet been analyzed or described.

Coal of humus is not produced when we evaporate *in vacuo* at a moderate heat, hence I do not consider it as a regular component of humus, but as an altered humic acid, partially carbonized by heat. It was not produced in any of my researches, where heat was dispensed with.

In 1839, Peligot described a new acid under the name of glucic acid. My first knowledge of this discovery was from the researches of Mulder, who has made a series of experiments on humic acid, from soil and from the decomposition of sugar. This acid I have also separated from the sap of the sugar maple tree, and from that of the yellow and white birch. It exists also abundantly in the brown sugars of commerce, and in beet sugars, and is generally separated in the state of biglucate of lime. It is readily extracted by pouring a small quantity of alcohol on brown sugar, which takes up the biglucate of lime, which gives a buff colored precipitate with subacetate of lead.

It frequently happens that crenic, apocrenic and humic acids exist in brown sugar, and I think they arise from the decomposition of the glucic acid, by the action of ammonia generated in the process of boiling the syrup with pearlash or lime water.

Apoglucic acid exists in the sap of the sugar maple, and is convertible into the other organic acids very readily.

Analyses by Mulder, 1842.

Glucic acid is composed of C. 8, H. 10, O. 5.

Glucate of lime (gelatinous) consists of C. 38.42, H. 4.46, O. 33.90, and lime=23.20.

Apoglucic acid, dried at	120° centigrade,	is composed of	C. 18, H. 22, O. 10.
"	130° "	"	C. 18, H. 20, O. 9.
"	138° "	"	C. 18, H. 18, O. 8.

Apoglucate of lead, dried at 138°C., is composed of—

Carbon, - - - -	36.77 =	18 atoms.
Hydrogen, - - - -	3.10 =	18 "
Oxygen, - - - -	21.47 =	8 "
Oxide of lead, - -	38.66 =	1 "

Mode of formation of glucic acid from sugar, according to Mulder. 2 atoms of crystalized cane sugar consists of— - - 24 C., 44 H., 22 Ox.

7 atoms of water = - - - - - 14 H., 7 Ox.

3 atoms of glucic acid, - - - - 24 C., 30 H., 15 Ox.

11 atoms Sugar = (C. 6, H. 10, O. 5,) $\times$ 11 = 66 C., 110 H., 55 Ox., form, by decomposition—

3 atoms glucic acid = -	24 C.,	30 H.,	15 Ox.
1 atom ulmin = - -	40 C,,	32 H.,	14 Ox.
1 atom formic acid = -	2 C.,	2 H.,	3 Ox.
23 atoms water =		46 H.,	23 Ox.
	66 C.,	110 H.,	55 Ox.

Exposure to air converts glucic acid into 1 atom apoglucic acid and 1 atom of humin. Humin is composed of—

Carbon, - - - -	64.67 =	40 atoms.
Hydrogen, - - - -	4.32 =	30 "
Oxygen, - - - -	31.01 =	15 "

Humic acid, according to Mulder, is compssed of—

Carbon, - - - -	64.58 =	40 atoms.
Hydrogen, - - - -	4.22 =	32 "
Oxygen, - - - -	27.46 =	13 "
Nitrogen, - - - -	3.74 =	2 "

The nitrogen came from the ammonia; for humate of silver gave, when dried at 100° cent.—

			Calculated.
Carbon, - -	49.05 =	40 atoms.	49.36
Hydrogen, - - -	3.24 =	30 "	3.02
Oxygen, - -	24.38 =	15 "	24.21
Oxide of silver, - -	23.14 =	1 "	23.41

Sprengel and Malaguti analyzed humic acid, and found it to consist of C. 30, H. 30, Ox. 15.

The humic acid from soil, consists of—

Carbon, - - - - -	58.00
Hydrogen, - - - - -	2.10
Oxygen, - - - - -	39.90

That from sugar consists of—

Carbon, - - - - -	57.48
Hydrogen, - - - - -	4.76
Oxygen, - - - - -	37.76

Here we observe a marked difference in the results of Mulder and those of Sprengel and Malaguti. The difference probably arose from the different degrees of dryness of the acid analyzed. Mulder considers the brown substance formed by the action of sulphuric acid on sugar, as ulmin and ulmic acid, and the black substance as humin and humic acid. When the sugar and acid are boiled *in vacuo, no ulmin or ulmic acid, humin or humic acid is formed.* He regards the pressure of the atmosphere as essential to the catalysis. The action of the atmosphere is not regarded as influencing the result by furnishing oxygen, it being found that nitrogen or hydrogen gasses might be substituted for air, and the catalytic action would still take place.

On examining his analyses of humic acid from the *soil*, we remark that he always obtained *nitrogen.* This I apprehend was owing to his not having removed the insoluble crenates and apocrenates from the soil; for by a repetition of the anlyses, I find that after boiling a soil, first with alcohol and then with water, there still remains a considerable proportion of the crenic and apocrenic acids in combination with earthy bases and metallic oxides. The alcohol and water take up, it is true, all the *free* crenic and apocrenic acids and their soluble salts; but those form only a small proportion of the amount contained in the soil. His researches are very elaborate, and highly interesting, and have been justly commended by Berzelius.

According to Mulder, it is easy to convert sugar, by the action of hydro-chloric or sulphuric acid, into ulmin, humin, humic acid, glucic, apoglucic and formic acids; and since this is a decomposition of that substance, may we not conceive that while plants are capable of reducing even carbon from carbonic acid, they also possess the power of converting humic acid first into apoglucic acid, then into glucic acid, and lastly into dextrine sugar, starch, or even into oxalic acid?

Now, by experimental researches, it appears that while plants take up humic acid, so soon as it enters the plant it becomes changed, and we actually find it in the state of glucic acid in the sap of the sugar maple, and in that of the white and yellow birch tree. We find, also, a large proportion of sugar in the maple. It is easy to conceive how these changes take place in the plant.

By analysis, a peculiar nitrogenized principle is also found in maple sap, which appears to consist in part of diastase and albumen. These ingredients may act as converters of humus into sugar; for we know that diastase will effect this change in starch in a very rapid manner.

On the other hand, we ask what becomes of the organic matters of soils, which must of necessity enter into the sap vessels of plants, by endosmose? Are they not changed into other matters in the course of their circulation in the sap vessels? They disappear while the plant thrives by their absorption. How can sugar be formed by atmospheric causes in a tree, before the green foliage is put forth? The nitrogenized substances of the soil appear to be absorbed chiefly at the period of inflorescence and fructification; for a large share of the nitrogen goes to the formation of the fruit. It is at this period that plants appear to exhaust most rapidly the soil.

After giving the above account of the composition of the organic matters of soils, it will be unnecessary to enter into any examination of the calculations of Dr. Dana, contained in Prof. Hitchcock's Report, and Webster's edition of Leibig's Organic Chemistry of Agriculture; for it will be seen in an instant that those calculations are based on erroneous data; and since the Geine theory has been generally abandoned, it will not require any refutation.

It is to be hoped that some chemist will give the American public a translation of the

elaborate researches on the organic matters in soils, contained in the 8th volume of Berzelius' Lehrbuch der Chemie, where the subject is fully examined.

The action of apocrenic acid on vegetation I have examined experimentally, by mixing a little apocrenate of potash, (obtained by the decomposition of apocrenate of copper by pure potash,) with pure pulverized rock crystal, (quartz,) a comparative experiment being made with the quartz and rain water. The result was that green crops of corn, barley, rye, oats and beans, weighed from 4½ to 5 times as much when grown in the quartz containing apocrenate of potash, as they did when grown in the quartz with water. The experiment was also tried in test tubes, using solutions, and all the plants tried, absorbed the apocrenate and removed it from the water, diminishing its color. In experiments I find that ammoniacal salts act through the medium of the organic acids most favorably, and have no action in pure quartz, nor even in quartz containing all the mineral salts of plants, no fruit being produced in a single instance unless organic matter was present.

(B)

ANALYSES OF SOILS.

Haverhill, N. H., Nov. 25, 1841.

Dr. Jackson:

Sir—I send you some specimens of soil on my farm, viz:

No. 1, is high intervale, excellent for corn, grass, oats; and we usually get very good wheat.

No. 2, is intervale, annually flowed, low meadow, as we call it, but not the lowest; yields from 1½ to 2 tons of good English hay per annum; was never plowed; has been mowed more than 60 years.

No. 3, is a specimen taken from "Coventry meadows," formerly so called, now "Benton flats;" these lands produce good grass and oats—too low and cold for corn or wheat; the specimen was taken from land recently brought into cultivation. Quere, will lime be beneficial, sowed broadcast on the furrow and harrowed in?—or will it be better applied in compost?

No. 4, is a specimen taken from my upland; this is also a good piece of land for corn, wheat, grass, &c., &c.

Very respectfully, yours &c.,

JOHN PAGE.

Examination of the texture of soils of Haverhill, received from Gov. John Page of Haverhill.

Mechanical analyses. 1000 grains of soil from Gov. Page's farm, Haverhill.

Soil "No. 1."

Remained on No. 1 Sieve,	000
" " 2 "	5
" " 3 "	995
	1000

Soil "No. 2."

Remained on No. 1 Sieve,	6
" " 2 "	16
" " 3 "	978
	1000

Soil "*No.* 3."

Remained on No. 1 Sieve,	4
" " 2 "	14
" " 3 "	982
	1000

Soil "*No.* 4."

Remained on No. 1 Sieve,	78
" " 2 "	130
" " 3 "	792
	1000

Sieves used in sifting the soils had the following sizes: No. 1, 1-8 inch meshes; No. 2, 1-50 inch, (a fine gauze seive;) No. 3 is the fine loam which passed both sieves, and from this the samples were taken for the chemical analyses.

Chemical Analyses of Soils from Haverhill.

Soils from Gov. Page's farm, Haverhill Corner.

100 grains yielded— *No.* 1.

Water,	1.
Vegetable matter,	3.7
Peroxide iron,	3.3
Carbonate lime,	1.3
Alumina,	4.8
Insoluble silicates,	84.4
	98.5
Loss,	1.5
	100.0

No. 2.

Water,	2.2
Vegetable matter,	5.
Insoluble silicates,	81.
Peroxide iron,	5.
Lime,	1.4
Alumina,	4.9
	99.5
Loss,	0.5
	100.0

No. 3.

Water,	4.3
Silica,	13.8
Vegetable matter,	70.8
Peroxide iron,	5.1
Carbonate lime,	0.9
Alumina,	5.0
	99.9
Loss,	0.1
	100.0

No. 4.

Water,	2.8
Vegetable matter,	7.5
Insoluble silicates,	81.2
Peroxide iron,	3.3
Carbonate lime,	1.1
Alumina,	4.5
	100.4
Excess,	.4
	100.0

Organic Analysis of Soils from Haverhill. (*No.* 1.)

1000 grains of soil from Gov. Page's farm, Haverhill, was digested in alcohol, which dissolved 0.6 grains, consisting of—

Apocrenic acid,	.059 "
Crenic acid,	.09
	.149
	.451
	.600

.451 grain consists of lime and magnesia, sulphates and chlorides.

The soil was then digested in water, and 1.4 grains were dissolved, which consisted of organic matter, 1.0 grains, 0.4 grains of lime, magnesia, phosphates, sulphates and chlorides.

The soil then being digested in carbonate of ammonia, 6.0 grains were dissolved, consisting of apocrenic acid, 1.88 grains; crenic acid, .52; humic acid, .073; extract of humus, 0.6; coal of humus, 0.2.

The organic matters of the soil, soluble in water and alcohol, consist of apocrenic acid, .059 grains; crenic acid, .009; .451 lime, magnesia, sulphates and chlorides; organic matter, 1.0 grains.

The organic matter, soluble in carbonate ammonia, consists of apocrenic acid, 1.88 grains; crenic acid, .52; humic acid, .073; extract of humus, .06; coal of humus, .02.

1000 grains soil, marked "No. 2," from Gov. Page's, Haverhill, was digested in alcohol, 1. grain soluble, consisting of—

Apocrenic acid,	0.034 grains.
Crenic acid,	0.014
Sub-crenate lime,	0.900
	0.948

1.000
.948

.052 grains lime, magnesia, sulphates and chlorides.

The soil was then digested in water, 11.0 grains soluble, consisting of organic matter, 0.8.

11.
0.8

10.2

10.2 grains consist of lime, magnesia, sulphates and chlorides.

The soil being then digested in carbonate ammonia, 25.4 grains were soluble, consisting of—

Apocrenic acid, - - -	6.17
Crenic acid, - - -	3.69
Humic acid, - - -	0.43
Extract humus, - - -	5.00

Mechanical Analyses of Soils from 1st, 2d and 3d terraces of Connecticut river, Charlestown, N. H.

Mechanical analysis of 1000 grains.

Soil No. 1.

Remained on No. 1 Sieve, 1-8 inch meshes,	20
" " 2 " 1-50 "	80
" " 3 "	900
	1000

Soil No. 2.

Remained on No. 1 Sieve, 1-8 inch meshes,	25
" " 2 " 1-50 "	205
" " 3 " fine loam,	770
	1000

Soil No. 3.

Remained on No. 1 Sieve,	30
" " 2 "	86
" " 3 " fine loam,	884
	1000

Analysis of 100 grains.

No. 1.

Water, - - - - -	2.4
Vegetable matter, - - -	4.2
Insoluble silicates, - - -	81.0
Peroxide iron, - - - -	4.5
Alumina, - - - - -	4.0
Salts of lime. - - - -	4.0
	100.1
Excess, - - - -	.1
	100.0

No. 2.

Water, - - - - -	3.4
Vegetable matter, - - - -	8.1
Insoluble silicatcs, - - -	78.0
Peroxide iron, - - - -	4.6
Alumina, - - - - -	4.3
Salts of lime, - - - -	.1
	99.4
Loss, - - - - -	.6
	100.0

No. 3.

Water,	3.2
Vegetable matter,	5.0
Insoluble silicates,	79.2
Peroxide iron,	7.3
Alumina,	5.1
Salts of lime	0.3
	100.1
Excess,	.1
	100.0

Mechanical separation of 1000 *grains of Soil from Upper Interval, Connecticut river, Orford.*

Remained on 1st Sieve,	00
" 2d "	62 grains fine sand.
" 3d "	938 grains fine loam.
	1000

Chemical Analysis.

100 grains, analyzed, yielded—

Insoluble silicates,	80.7
Peroxide iron,	3.5
Alumina,	4.5
Salts of lime,	0.9
Magnesia,	0.24
Vegetable matter,	6.7
Water,	3.5
	100.04
Gain,	.04
	100.00

Mechanical separation of 1000 *grains of Soil from upland, Connecticut river, Orford.*

Gravel, &c.,	No. 1,	153	pebbles, vegetable fibre and fine sand.
Sand,	No. 2,	184	
Fine loam,	No. 3,	663	grains fine loam.
		1000	

Chemical Analysis of 100 *grains.*

Insoluble silicates,	76.7
Peroxide iron,	5.3
Alumina,	4.2
Salts of lime,	1.0
Magnesia,	0.4
Vegetable matter,	9.2
Water,	3.7
	100.5
Gain,	.5
	100.0

Mechanical separation of 1000 *grains of soil from Lower Interval, Connecticut river, Orford.*

Gravel, &c.,	No. 1,	00
Sand,	No. 2,	4
Fine loam,	No. 3,	996
		1000

Chemical analysis of 100 *grains.*

Insoluble silicates, - - - -	82.2
Peroxide iron, - - - - -	3.9
Alumina, - - - - -	3.2
Salts of lime, - - - - -	1.6
Magnesia, - - - - -	.4
Vegetable matter, - - - - -	5.8
Water, - - - - -	2.7
	998
Loss, - - - - - -	.2
	100.0

A solution of 1000 grains in water gave traces of soda lime and alumina.

Organic analysis of 1000 *grains soil from Connecticut river alluvion, Orford.*

1000 grains of soil was digested in alcohol—2.4 grains soluble, consisting of—

Apocrenic acid, - - - -	0.09
Crenic acid, - - - - -	0.17
Sub-crenate of lime, - -	0.60
	0.86

1.54 grains consist of magnesia, lime, chlorides and sulphates.

The soil was then digested in water; 1 grain soluble consisting of organic matter, 0.6 grains. 0.4 grain consists of sulphates, chlorides, lime, magnesia and potash.

The soil was digested in carb. ammonia; 19.6 grains soluble, consisting of—

Apocrenic acid, - - - -	0.73
Crenic acid, - - - - -	0.72
Humic acid, - - - -	0.57
Extract of humus, - - -	7.40
	9.42

Besides this there were 8 grains of organic matter, insoluble in the carb. ammonia, and consisting of undecomposed organic matter of vegetable origin.

Mechanical analysis of 1000 *grains soil from Enfield Shakers' farm, Canaan; color, light yellowish brown.*

Remained on No. 1 sieve, - -	000.
" " 2, sand, - -	4.
" " 3, fine loam, -	996.
	1000.

Chemical analysis of 100 *grains.*

Water,	4.5
Vegetable matter,	2.3
Insoluble silicates,	86.7
Peroxide of iron,	4.9
Lime,	0.6
	99.0
Loss,	.1
	100.0

Mechanical analysis of 1000 *grains soil from the farm of Mr. Wells, Lancaster.*

Remained on No. 1 Sieve,	97
" " 2 "	129
" " 3 "	774
	1000

Chemical analysis of 100 *grains.*

Water,	4.4
Vegetable matter,	7.3
Insoluble silicates,	79.5
Peroxide of iron,	5.5
Alumina,	3.6
Lime,	.3
	100.6—0.6 gain.

Analysis of 100 *grains of cultivated soil from E. Bailey's farm, Acworth.*

Mechanical separation of 1000 grains.

Remained on Sieve No. 1,	165	grains mica slate pebbles.
" " " 2,	110	grains small pebbles.
" " " 3,	725	grains fine loam.
	1000	

Chemical analysis of 100 grains, yielded—

Insoluble silicates,	76.6
Peroxide iron,	4.
Alumina,	3.
Phosphate, sulphate and crenate lime,	0.9
Vegetable matter,	9.6
Water,	4.9
	99.0
Phosphate of alumina traces and loss,	1.
	100.

Mechanical separation of 1000 *grains of soil from E. Bailey's Farm, Acworth.*

Remained on 1st Sieve,	154 grains coarse pebbles.
" 2d "	243 grains fine pebbles.
" 3d "	603 grains fine loam.
	1000

44

Chemical analysis of 100 grains yielded—

Insoluble silicates,	77.6
Peroxide iron,	4.5
Alumina,	3.4
Phosphate and crenate of lime,	0.3
Magnesia,	0.44
Vegetable matter,	8.3
Water,	5.2
	99.74
Phosphoric acid traces and loss,	.26
	100.00

Mechanical separation of 1000 *grains exhausted soil from Dr. Jarvis' Farm, Claremont.*

Remained on 1st Sieve,	24 grains coarse pebbles.
" 2d "	90 grains fine pebbles.
" 3d "	886 grains fine loam.
	1000

Chemical analysis of 100 grains yielded—

Insoluble silicates,	84.4
Peroxide iron,	3.6
Alumina,	2.9
Salts of lime,	1.0
Magnesia,	0.1
Vegetable matter,	4.9
Water,	3.0
	99.9
Loss,	.1
	100.0

Mechanical separation of 1000 *grains fertile soil from Dr. Jarvis', Claremont.*

Crops, grass, 1½ tons to the acre; wheat since, 40 bushels to the acre.

No. 1,	200, mica slate and quartz pebbles.
No. 2,	95, some vegetable fibre, fine.
No. 3,	705, a great deal of mica, very minute.

Chemical Analysis.

Water,	3.3
Vegetable matter,	6.5
Peroxide iron,	3.8
Alumina,	4.0
Carbonate lime,	0.8
Silica,	81.5
	99.9
Loss,	0.1
	100.0

Analysis of soil from Mr. Putnam's Farm, Lyndeborough.

Mechanical analysis of 1000 grains.

Remained on No. 1 Sieve, granite,	230	grains.
" " 2 " sand,	70	"
" " 3 " fine loam,	700	"
	1000	

Chemical analysis of 100 grains yielded—

Water,	4.4
Vegetable matter,	9.6
Insoluble silicates,	76.8
Peroxide iron,	6.0
Lime,	0.4
Alumina,	0.4
	96.6
Loss,	.4
	100.0

Mechanical Analysis of soil from Mr. Putnam's Farm, Lyndeborough—Turnip Field.

Remained on No. 1 sieve,	300	grains.
" " 2, sand,	230	"
" " 3, fine loam,	470	"
	1000	

Chemical analysis of 100 grains yielded—

Water,	5.4
Vegetable matter,	8.8
Insoluble silicates,	75.2
Peroxide iron,	6.4
Alumina,	2.0
Lime.	3.0
	100.8
Excess,	.8
	100.0

Analysis of soil, grass land, from Thomas Fisk's, Dublin.

No. 1.

Chemical analysis of 100 grains gave—

Water,	3.8
Vegetable matter,	8.6
Siliceous matter,	77.6
Alumina and peroxide iron,	8.0
Salts of lime,	0.4
Phosphate magnesia,	0.6
	99.0
Loss,	1.0
	100.0

Soil No. 2.—Mr. Fisk's, Dublin. Subsoil—granitic.

Chemical analysis of 100 grains yielded—

Water, - - - - -	1.8
Vegetable matter, - - - -	5.4
Siliceous matter, - - - -	84.4
Alumina and peroxide iron, - -	6.8
Salts of lime, - - - -	0.30
Magnesia, - - - - -	0.8
	99.50
Alkalies and loss, - - - -	.5
	100.00

Soil from Mr. Fisk's, Dublin, No. 3.

Chemical analysis of 100 grains yielded—

Water, - - - - -	5.6
Vegetable matter, - - - -	5.4
Siliceous matter, - - - -	76.2
Peroxide iron, - - - - -	10.8
Salts of lime, - - - -	0.6
	98.6
Loss, - - - - -	1.4
	100.0

Soil from Mr. Fisk's, Dublin, No. 4.

Chemical analysis of 100 grains yielded—

Water, - - - - -	3.2
Vegetable matter, - - - -	7.0
Siliceous matter, - - - -	80.4
Peroxide iron, - - - -	9.0
Salts of lime, - - - -	1.4
Magnesia, - - - - -	0.3
	101.3

Analysis of rich soil of Cow Island, Winnipissiogee Lake.

Mechanical Analysis of 1000 grains soil from Cow Island, Derby Farm.

Corn crop, 130 bushels per acre—land highly manured.

200 grains coarse gravel from granite rocks.
275 grains sand of quartz, felspar and mica.
525 grains fine loam, of a yellow brown color.

Chemical Analysis of 100 grains.

Insoluble silicates, - - -	83.60
Peroxide iron and manganese, -	4.10
Alumina, - - - -	1.40
Phosphates and other salts of lime, -	0.70
Magnesia, trace,	
Organic matter - - - -	7.10
Water, - - - - -	2.70
Potash and loss, - - - -	0.40
	100.00

Chemical Analysis of the organic matters and salts in a very rich soil on Cow Island, E. H. Derby's Farm.

Yields 130 bushels of corn to the acre.

100 grains of this soil yield to boiling water 4.2 grains of soluble organic matter, which colors the water yellow. It reddens litmus paper slightly.

The mineral matter and salts, separated, amounted to 1.30 grains, and the organic matters to 2.90 grains.

The organic matters tested were found to consist of crenic and apocrenic acids, which gave the usual salts, with acetate of copper.

The mineral matters and salts were silicic acid, chlorides, sulphates and phosphates.

The bases were magnesia, lime, alumina, potash and oxide of iron.

150 grains of the same soil yielded, when digested at 140° F. with a solution of carbonate of ammonia, a deep copper brown solution, which, on analysis, was found to contain—

			per cent.
Crenic acid,	0.5	=	0.333
Apocrenic acid,	1.2	=	0.800
Humic acid, extract of humus,	1.9	=	1.266
	3.6		2.399

The two last mentioned matters were then marked 1st and 2d new extracts.

The extract of humus was decomposed into two new substances, one of which gave a precipitate with protonitrate of mercury, and the other was thrown down by a solution of nitrate of silver.

This analysis was made before Berzelius' new work had reached this country. On receiving that admirable work, the new matters were identified with those discovered and and described by him, and his names were adopted as above given.

Mechanical separation of 1000 *grains of soil from Long Island, Winnipissiogee Lake—soil poor and cold.*

Sifted,	No. 1, gravel,	300 grains	granite pebbles.
	No. 2, sand,	195 "	
	No. 3, loam,	505 "	fine loam.

Chemical analysis of 100 *grains.*

Insoluble silicates,	86.75
Peroxide iron,	2.6
Alumina,	3.15
Salts of lime,	0.5
Magnesia,	0.2
Vegetable matter,	4.8
Water,	2.0
	100.0

Mechanical separation of 1000 *grains of soil from Long Island, Lake Winnipissisgee; crop,* 130 *bushels corn per acre.*

No. 1, gravel,	90 grains	coarse pebbles.
No. 2, sand,	260 "	fine pebbles.
No. 3, loam,	650 "	fine loam.

Chemical Analysis of 100 *grains.*

Insoluble silicates,		80.8
Peroxide iron,		2.2
Alumina,		4.
Salts of lime,		0.4
Magnesia,	a trace.	
Phosphate alumina,	a trace.	
Vegetable matter,		8.7
Water,		3.9
		100.0

500 grains of the soil was digested in boiling water—2.3 grains dissolved. The solution was of a yellow color and consisted of—

Vegetable matter,	2.0
Mineral matter,	0.3
	2.3 grains.

The residue from the solution before burning was acid, and after burning, alkaline. The acid was then a vegetable acid. The following substances were taken up by the water, viz: muriatic, sulphuric, carbonic and phosphoric acids, soda, lime magnesia, silica, iron and manganese.

Analysis of 100 *grains soil from the farm of J. Coe, Centre Harbor; soil never manured.*

Insoluble silicates,	88.
Peroxide iron,	2.5
Alumina,	3.3
Salts of lime	0.5
Magnesia,	0.25
Vegetable matter,	3.6
Water,	1.7
	99.85
Loss,	.15
	100.00

Analysis of Peats, Marls and Clays.

Shaker Village, Canterbury, Oct. 12, 1840.

Dr. Jackson:

I herewith send you a few specimens of the different soils which principally compose our farm. My object is to gain a practical knowledge of the soils, so as to render the good better and the poor productive.

No. 1, contains a portion of the large peat bog which you examined when at our village.

No. 2, was taken from our garden—soil naturally good, and by cultivation brought to a high state of productiveness. (Is not this soil, (No. 2,) too heavy for the peat compost?)

No. 3, is a very weak soil, rather moist than otherwise, producing only white birch bushes and wild golden-rod, (Solidago,) and will not retain the manure applied, more than one or two years.

No. 4, is the subsoil of the above, (No. 3.) (Would not these two intimately mixed, form a good soil?)

No, 5, was taken from the best natural grass land we have—probably as good as any in the country.

No. 6, is the stone I mentioned to you, which I suppose is some combination of iron with some of the earths.

Thanking you for your liberality in communieating your sentiments in regard to soils, manures, &c., and happy to render you all the assistance in our power,

I remain, yours truly,

WM. TRIPURE.

Chemical Analysis of Soil from Shakers, Canterbury—No. 2.

Water, - - - - -	4.5
Vegetable matter, - - - -	9.9
Insoluble silicates, - - -	77.2
Peroxide iron, - - - - -	3.3
Alumina, - - - - -	2.8
Lime, - - - - - -	1.8
Magnesia, - - - - -	1.0
	100.5

Chemical Analysis of 100 *grains soil from Shakers, Canterbury; subsoil, No.* 4.

Insoluble silicates, - - - -	90.2
Peroxide iron, - - - -	2.2
Alumina, - - - - -	3.
Salts of lime, - - - -	0.2
Magnesia, a trace.	
Vegetable matter, - - - -	2.88
Water, - - - - - -	1.60
	100.08
Gain, - - - - - -	.08
	100.00

Chemical Analysis of 100 *grains Shaker soil, No.* 5; *best natural grass land.*

Siliceous matter, - - - -	81.60
Peroxide iron, - - - -	3.
Alumina, - - - - -	2.3
Salts of lime, - - - - -	0.1
Magnesia, - - - -	0.12
Vegetable matter, - - - -	10.05
Water, - - - - -	2.75
	99.92
Loss, - - - - -	.08
	100.00

Mechanical separation of 1000 *grains of Soil from J. P. Stickney's farm, upper alluvion of the Merrimack, Concord.*

Remained on No. 1 Sieve, -	15 undecomposed vegetable fibre.
Small gravel and vegetable fibre, No. 2,	100 grains pebbles.
No. 3, fine loam.	885 "
	1000

Chemical analysis of 100 grains yielded—

Insoluble silicates,	77.4
Peroxide iron,	3.6
Alumina,	4.5
Salts of lime,	1.2
Magnesia,	.2
Vegetable matter,	9.3
Water,	3.9
	100.1
Gain,	.1
	100.0

Mechanical separation of 1000 *grains of Soil from J. P. Stickney's farm, Concord—lower alluvion of the Merrimack.*

Remained on No. 1 Sieve,	00		
" " 2 "	50	grains	pebbles.
" " 3 "	950	"	fine loam.

Chemical analysis of 100 grains yielded—

Insoluble silicates,	79.9
Peroxide iron,	3.5
Alumina,	4.4
Salts of lime,	0.9
Magnesia,	0.3
Vegetable matter,	7.5
Water,	3.2
	99.7
Loss,	.3
	100.0

1000 grains uncultivated soil from the alluvion of the Merrimack were digested in alcohol. 0.8 grain was soluble, consisting of—

Apocrenic acid,	.042
Crenic acid,	.014
	.056

0.800
.056

0.744 grains lime, magnesia, sulphates and chlorides.

The soil was then digested in water—3.2 grains soluble consisting of—

Organic matter,	1.8 grains,
Mineral salts,	1.4 " consisting of lime

magnesia, sulphates and chlorides.

The soil was then digested in carb. ammonia; 19.4 grains soluble consisting of—

Apocrenic acid,	5.90 grains.
Crenic acid,	1.20
Humic acid,	1.46
Extract of humus,	2.40
Bases and salts,	8.44
	19.40

100 *grains micaceous soil from Levi Bartlett's, Warner, of a greyish white color. It is derived from decomposed mica slate rocks, and contains—*

Water,	3.6
Vegetable matter,	1.8
Insoluble silicates,	79.2
Peroxide iron and alumina,	5.6
Potash,	2.2
Soda,	2.5
Lime,	3.2
Carbonate of magnesia,	1.2
	99.3

Mechanical analysis of 1000 *grains soil from the farm of Mr. Levi Bartlett, Warner.*

Remained on No. 1 Sieve,	5
" " 2 "	36
" " 3 "	959
	1000

Chemical analysis of 100 grains yielded—

Water,	1.3
Vegetable matter,	2.5
Insoluble silicates,	85.5
Peroxide iron,	8.0
Alumina,	2.7
Lime,	0.6
	100.6
Excess,	.6
	100.0

Chemical analyses of soils from the farm of Hon. T. Chandler, Bedford.

No. 1.

Vegetable matter and water,	4.4
Insoluble silicates,	90.4
Iron,	1.0
Alumina,	4.8
Lime,	.4
	101.0

No. 2

Vegetable matter and water,	4.5
Insoluble silicates,	90.0
Peroxide iron,	2.2
Alumina,	3.0
Lime,	0.7
	100.4

No. 3.

Vegetable matter	76.0
Insoluble silicates,	18.5
Peroxide iron and alumina,	2.3
Lime,	3.5
	100.3

Soil No. 1, was taken from an old cultivated field:
No. 2, from an old field a long time in rye and pasturage, considered exhausted:
No. 3, from a swamp or run.

Bedford, N. H., Jan. 21st, 1843.

DR. JACKSON—

Sir: I have sent you a box of soils, which I wish you to analyze. The numbers on the bags indicate the localities, and I have kept a list so as to refer to them when your report is published.

Field No. 1, has been under cultivation 100 years. Its produce is small, and it is inclined to run into sorrel. It has been but little manured.

Field No. 2, has been under cultivation 100 years, without manure, but has been in rye so long as it would bear a crop.

Field No. 3, a piece of sour land, never ploughed. It yields a poor sort of hay. I wish you to say what this land wants to make it productive. The muck I send you, (No's 1 and 2,) I wish you to analyze, and say what proportion it will bear with manure, or lime, plaster and ashes.

Field No. 4, produce small.

WILLIAM PATTEN.

Analysis of Bedford soil No. 1, *from Wm. Patten. Mechanical separation of* 1000 *grains.*

Remained on No. 1 Sieve,	27	grains pebbles.
" " 2, "	58	"
" " 3, "	915	"
	1000	

Chemical analysis of 100 *grains.*

Vegetable matter,	4.0
Insoluble silicates,	91.4
Peroxide of iron,	1.4
Alumina,	3.0
Salts of lime,	1.0
	100.8
Excess,	0.8
	100.0

Soil No. 2—Mr. Patten, Bedford.

Remained on No. 1 Sieve,	20	grains.
" " 2 "	66	"
" " 3 " fine loam,	914	"
	1000	

Chemical Analysis of 100 *grains.*

Vegetable matter,	6.0
Insoluble silicates,	87.4
Peroxide iron,	1.0
Alumina,	4.0
Salts of lime,	1.4
	99.8
Loss,	0.2
	100.0

Analysis of Wm. Patten's soil No. 3, *Bedford; dark ash color. Mechanical separation of* 1000 *grains.*

Remained on No. 1 Sieve,	12	grains.
" " 2 "	26	"
" " 3 "	962	"
	1000	

Chemical analysis of 100 *grains.*

Vegetable matter,	8.0
Insoluble silicates,	87.4
Peroxide of iron,	0.8
Alumina,	2.6
Lime,	.6
	99.4
Loss,	0.6
	100.0

Analysis of soil from Bedford, field No. 4. *Mechanical separation of* 1000 *grains.*

Remained on 1st Sieve,	12	grains.
" 2d "	43	"
" 3d "	945	"
	1000	

Chemical Analysis of 100 *grains.*

Vegetable matter,	9.
Insoluble silicates,	83.6
Peroxide iron,	1.6
Alumina,	4.6
Lime,	1.4
	100.2
Excess,	.2
	100.0

Analysis of Swamp Muck from Mr. Patten's farm, Bedford. No. 1.

Chemical analysis of 100 grains yielded—

Vegetable matter,	93.0
Insoluble silicates,	3.6
Peroxide iron,	0.8
Alumina,	0.6
Lime,	1.0
	99.0
Potash, salts and loss,	1.0
	100.0

Analysis of Muck, No. 2, from Mr. Patten's farm, Bedford.

Chemical analysis of 100 grains yielded—

Water, - - - - -	5.8
Vegetable matter, - - - -	89.6
Insoluble silicates, - - -	1.8
Peroxide iron, - - - - -	0.8
Alumina, - - - - -	1.0
Lime. - - - - - -	0.6
	99.6
Potash, salts and loss, - -	0.4
	100.0

Mr Patten's soils evidently need a more liberal supply of manure, and since he has swamp muck enough, he can make a compost with 2 loads of muck and 1 load of barn yard manure, and may pour all the urine he can obtain on the heap, and let it remain until the spring. Then dig it over and mix in 1 bushel of lime, recently dry slaked, with water for every load of compost. When he does this, sprinkle the heap with ground plaster of Paris, to retain the ammonia if any smell arises from liming the manure. Put 30 loads of manure to the acre every year, while the field is up; and then spread ashes and sow with wheat, barley or rye, and lay down to grass, sprinkling ground plaster on the soil when he sows it. In a few years he will have a rich soil.

Analysis of Peat, from the Shakers, Canterbury.

100 grains of the thoroughly dried peat contain—

Vegetable matter, - - - -	93.8
Mineral matter, - - - -	6.2
	100.0

The mineral matter consists of—

Insoluble silicates, - - - -	3.9
Sulphate, phosphate and carbonate of lime,	1.2
Alumina and peroxide iron, - - -	1.1
	6.2

Analysis of Peat from Shakers, Canterbury; color, dark brown.

Chemical analysis of 100 grains yielded—

Water, - - - - -	13.7
Vegetable matter, - - - -	62.9
Insoluble silicates, - - - -	20.6
Peroxide iron, - - - -	1.3
Lime, - - - - -	0.7
	99.2
Loss, - - - - -	0.8
	100.0

Analysis of 100 *grains Peat from the farm of Mr. Magoon, Lyndeborough.*

Water,	21.0
Vegetable matter,	66.7
Insoluble silicates,	4.7
Peroxide iron and alumina,	2.3
Salts of lime,	5.4
	100.1
Excess,	0.1
	100.0

Analysis of 100 *grains Peat from a potatoe hill where the plants did not thrive, from the farm of Mr. Magoon, Kingston. Potatoes and corn sickly yellow on this kind of peat.*

Water,	15.0
Vegetable matter,	82.6
Sil. ashes and peroxide iron from sulph. of iron,	2.4
	100.0

This peat contains free acid.

Analysis of 100 *grains of Peat from a potatoe hill from the farm of Mr. Magoon, Kingston, where the plants grew well.*

Water,	15.4
Vegetable matter,	78.0
Ashes containing lime, potash, &c., from the ashes of burnt stumps of trees,	6.6
	100.0

Analysis of Peat from Franconia.

100 grains of the thoroughly dried peat gave—

Vegetable matter,	73.7
Mineral matter,	26.3
	100.0

The mineral matter consists of—

Silica,	18.3
Peroxide iron,	4.0
Sulphate lime,	3.8
Magnesia,	0.2
	26.3

Analysis of Peat from Meredith, compact—large quantity of bituminous matter.

100 grains of the thoroughly dried peat contains—

Vegetable matter,	94.9
Mineral matter,	5.1
	100.0

The mineral matter consists of—

Silica,	2.1
Alumina,	1.0
Salts of lime,	2.0
	5.1

The salts of lime are the sulphate, phosphate and crenate of lime.

Analysis of Marl.

Chemical analysis of 100 grains dry marl, Hanover, yielded—

Insoluble matter, - - -	83.
Peroxide iron, - -	10.
Carbonate of lime, - - -	2.2
Vegetable matter and water, -	4.8
	100.0

Analysis of clay Marl from Brattleborough, Vt.

Chemical analysis of 100 grains yielded—

Water, - - - - -	4.6
Vegetable matter, - - - - -	4.2
Peroxide iron, - - - -	2.0
Carbonate of lime, - - -	56.6
Alumina, - - - - -	4.2
Magnesia, - - - - -	0.0
Insoluble silicates, - - -	28.0
	99.6
Loss, - - - - - -	.4
	100.0

Analysis of Clay from Piermont.

Chemical analysis of 100 grains yielded—

Water, - - - - -	0.6
Vegetable matter, - - - -	3.0
Insoluble silicates, - - - -	83.2
Peroxide ron, - - - - -	8.8
Carbonate of lime, - - - -	3.4
	99.0
Loss, - - - - -	1.0
	100.0

Chemical analysis of 100 *grains Marl from Lyme.*

Water, - - - - -	1.1
Vegetable matter, - - - -	2.8
Insoluble silicates, - - - -	79.5
Peroxide iron, - - - - -	4.3
Alumina, - - - - -	5.1
Carbonate of lime, - - - -	7.3
	100.1
Gain, moisture, - - - -	.1
	100.0

1.5 grains vegetable matter soluble in carbonate ammonia.

Chemical analysis of 100 *grains plastic dark blue Clay from Bath.*

Water,	1.8
Vegetable matter,	3.5
Insoluble silicates,	81.2
Peroxide iron,	6.7
Salts of lime,	1.7
Alumina,	5.
	99.9
Potash, soda and loss	.1
	100.0

The salts of lime are sulphates and crenates.

SOILS FROM ILLINOIS.

The following analyses I have made gratuitously, for the purpose of learning the composition of the soils of one of the best agricultural districts of the Western States.

The soils, with remarks on them, were sent to me by Dr. Silas Meacham of Chicago, Illinois.

They were put up in tin cannisters and came to me in good order.

In the mechanical separation of the particles of these soils, sieves of 1-8th and 1-50th inch meshes were used. The coarse fibres, roots, sticks and gravel were left on the first sieve and the sand on the second, while the fine loam passed through both of them.

The chemical analyses were divided into two series: the first was made on 100 grains of the soil, and gives the relative proportions of the mineral ingredients; while the second, or organic analysis, was performed on 1000 grains of the soil, and the organic acids and salts were separated with great care, the free and combined acids being separately determined.

The free organic acids were dissolved out by means of alcohol, and the saline matters by water. Then the combined organic acids were separated by means of a solution of carbonate of ammonia, and were precipitated, purified and weighed.

Chicago, 15*th March,* 1842.

Dear Sir: Dr. Meacham informed me that you were willing to analyze four specimens of prairie soil. I had the enclosed specimens prepared immediately, but found no opportunity to send them last fall, and this is the first opportunity that has offered since the close of navigation.

Dr. M. said you wished only four specimens, but as these six were sent, I thought it best to send them all. We should prefer that you would analyze No's 1, 3, 4 and 6, if you should not wish to examine more than those.

Mr. Long, who furnished some of them, says:

No. 1, is a specimen of interval, or bottom land. This land is used principally for Indian corn and garden vegetables, which come to great perfection on it; and I see no diminution in quantity or quality, after a cultivation of six years. In cultivating wheat, oats or barley, the straw is apt to grow too rank, and consequently lodge, and in a measure blast. The depth of this soil is very great.

No. 2, is from the first ridge of land above the bottom land, and is similar in its qualities, such as quickness of growth and fertility, to the high rolling prairie. It is good for all kinds of grain, which will ripen quicker than on the others. The subsoil is sand. We call it the easiest to till, though not so durable as,

No. 3, which is the gently undulating or "black muck" prairie. This land is very fertile, natural to grass, produces good wheat and corn, but perfects its growth slower than on No's 1 and 2. It ranges in depth from 6 inches to 2 feet and more, and the subsoil is clay, of which,

No. 4 is a specimen. I have found where this clay has been thrown out by digging, that it adds to the growth of vegetation, particularly trees.

I have taken the above specimens of soils, (4,) from land that has never been tilled; the first 3 numbers, 6 inches below the surface, and the subsoil, (No. 4,) 20 inches.

You will perceive that all the specimens contain small fibrous roots; so do the same soils, in an equal quantity, after a cultivation, (speaking from my own experience,) of six years.

Thus for Mr. Long.

All the descriptions of No's 5 and 6, that were furnished me, are on the tin cans.

I should think you would much enjoy a trip into this Western world. It is so entirely different from any thing you see at the East, that, as a Geologist, I should suppose an examination of our prairies, the mineral region, &c., would be very interesting. We should be happy to see you.

Will you please forward to me the result of the analyses for publication in the Union Agriculturist, as soon as convenient.

I send you the numbers of the present volume of the U. A., and if you consider the paper worth the postage, shall be happy to continue to forward them.

Very respectfully,

JNO. S. WRIGHT.

Dr. C. T. Jackson, Boston.

Chemical Analyses of rich soils sent to me by Dr. Silas Meacham of Chicago, Illinois.

Soil No. 1—interval or bottom land, good for Indian corn. In cultivating wheat, oats or barley, the straw grows too rank and lodges.

Mechanical Analysis of 1000 *grains.*		*Chemical Analysis of* 100 *grains.*	
Remained on 1st sieve,	3.0 grains.	Water and vegetable matter,	19.2 grains.
" 2d "	7.0 "	Silica,	67.5 "
Passed 2d sieve,	990.0 "	Peroxide of iron,	5.2 "
		Phosphate and sulph. of lime,	2.0 "
	1000.0	Alumina,	6.0 "

Organic Analysis of 1000 *grains. No.* 1.

Matter soluble in alcohol, 0.4 grains; consists of—

Apocrenic acid,	0.084 grains.
Crenic acid,	0.280 "
	0.364

Earthy salts, 0.036 grains; which consist of lime, sulphates, phosphates and chlorides.

Water dissolves 4.2 grains; solution, neutral; organic matter burnt off, 2.0 grains; salts left are lime, magnesia, sulphates, chlorides and phosphates; dissolved the portion not soluble in water, in nitric acid. It yielded magnesia, lime, chlorides, phosphates, sulphates and silex; whole amount of salts, 2.2 grains.

Solution of carbonate of ammonia dissolves 12.40 grains, which consist of—

Apocrenic acid,	7.78 grains.
Crenic acid,	1.34 "
Humic acid,	0.30 "
Extract of humus,	3.40 "
	12.82

Soil No. 2, from the first ridge of land above the bottom land; similar in its qualities to No. 1; good for all kinds of grain.

Mechanical analysis of 1000 *grains.*

Remained on 1st sieve,	0.0	grains.
" 2d "	4.0	"
Passed 2d sieve,	996.0	"
	1000.0	"

Chemical analysis of 100 *grains.*

Water, - - -	2.5	grains.
Vegetable matter, -	9.2	"
Insoluble silicates, - -	80.4	"
Peroxide of iron, - -	3.2	"
Phosphate and sulph. of lime,	1.4	"
Alumina, - -	3.3	"
	100.0	

Organic analysis of 1000 *grains.*

Soluble in alcohol, 1.4 grains; consists of—

Apocrenic acid, - - - 0.34
Crenic acid, - - - 0.38 } =0.72 grains.

Bases, 0.68 grains; consists of magnesia, lime, chlorides and sulphates.

Water dissolves 2.0 grains; solution, neutral; organic matters burnt off, 1.6 grains; bases and salts dissolved in water and acid, are lime, magnesia, sulphates, chlorides and phosphates; mineral salts amount to 0.4 grains.

Carbonate of ammonia dissolves 23.4 grains, which consists of—

Apocrenic acid. - - -	17.80	grains.
Crenic " - - - -	2.40	"
Humic " - - -	1.36	"
Extract of humus, - -	2.00	"
	23.56	"

Soil No. 3, the gently undulating or "black muck" prairie—fertile, natural to grass, produces good wheat and corn, and ranges in depth from 6 inches to two feet or more.

Mechanical analysis of 1000 *grains.*

Remained on Sieve No. 1,	1.0	grains.
" " " 2,	13.0	"
Fine loam, " 3,	986.0	"
	1000.0	

Chemical analysis of 100 *grains.*

Water, - -	4.0	grains.
Vegetable matter, -	16.3	"
Insoluble silicates, -	66.6	"
Peroxide iron, - -	6.8	"
Phosphate and sulphate of lime,	2.6	"
Alumina, - -	5.0	"
	101.3	

Organic analysis of 1000 *grains.*

Alcohol dissolves 2.8 grains, which consist of—

Apocrenic acid, - - 1.18
Crenic acid, - - - 0.28 } =1.46.

Mineral salts and bases, 1.34 grains—consists of magnesia, lime, chlorides and sulphates.

Water dissolves 3.0 grains; solution slightly alkaline; organic matter burnt off, 2.0 grains. Bases and salts soluble in water, are magnesia, lime, chlorides and sulphates—the insoluble remainder, lime, magnesia, sulphates, silex and mineral salts, 1.0 grains.

Carbonate of ammonia dissolves 14.4 grains, which consist of—

Apocrenic acid, - - -	8.38	grains.
Crenic acid, - - - - -	0.86	"
Humic acid, - - - -	0.94	"
Extract of humus, - - -	4.40	"
	14.58	

Soil No. 4, subsoil of No. 3. When put upon land, adds to the growth of vegetation, particularly trees—taken from land which has never been tilled.

Organic analysis of 1000 *grains.*

Soil No. 4 was soluble in alcohol, 0.6 grain, which consists of—

Apocrenic acid, - - 0.08 }
Crenic acid, - - - 0.18 } =0.26 grain.

Salts and bases, 0.34 grain, which consists of lime, magnesia, chlorides and sulphates.

Water dissolves 2.6 grains; solution neutral; organic matter burnt out, 2.0 grains; remainder dissolved in water, yielded lime, magnesia, chlorides and sulphates. Dissolved the insoluble bases in nitric acid, which yielded lime, magnesia, chlorides, sulphates and silex. Amount of mineral salts, 0.6 grain.

Carbonate of ammonia dissolves 6.0 grains, which consist of—

Apocrenic acid, - - -	2.74	grains.
Crenic acid, - - - - -	1.14	"
Humic acid, - - - -	0.42	"
Extract of humus, - - -	1.60	"
	5.90	

Soil No. 5, from the centre of a small prairie elevated fifty feet above Fox river, from the town of Elgin—superior for wheat.

Mechanical analysis of 1000 *grains.*

Remained on No. 1 sieve,	29	grains.
" " 2 "	142	"
" " 3 "	829	"
	1000	

Chemical analysis of 100 *grains.*

Water, - -	4.2	grains.
Vegetable matter, -	7.0	
Insoluble silicates, -	80.78	
Peroxide iron and alumina,	8.64	
Lime, - - -	.98	
	101.60	
Excess, - -	1.60	
	100.00	

Organic analysis of 1000 *grains.*

Soluble in alcohol, 1.0 grain, which consists of—

Apocrenic acid, - - - 0.16 }
Crenic acid, - - - 0.28 } =0.44 grain.

Bases and salts, 0.56 grain, which consists of lime, magnesia and chlorides.

Soluble in water, 3.0 grains; solution, neutral; organic matters burnt out, 2.2 grains; salts soluble in water are sulphates, lime, magnesia and chlorides; insoluble salts are sulphates, chlorides, carbonates, magnesia, lime and silica, 0.8 grain.

Carbonate of ammonia dissolves 14.0 grains; which consist of—

Apocrenic acid, - - -	8.9
Crenic " - - - - -	1.2
Humic " - - - - -	0.4
Coal of humus, - - - - -	2.2
Extract of humus, - - -	1.4
	14.1

Soil No. 6, from Elgin, Illinois—bottom land; light oak openings; elevated ten feet above Fox river; superior for corn.

Chemical analysis of 100 *grains.*

Water and vegetable matter, -	6.0 grains.
Insoluble silicates, - - - -	86.1 "
Peroxide of iron, - - -	2.5 "
Phosphate and sulphate of lime, -	1.4 "
Alumina, - - - - -	3.0 "
	99.0

Organic analysis of 1000 *grains.*

Alcohol dissolves 1.0 grain, which consists of—

Apocrenic acid, - - 0.16 grain. ⎫
Crenic " - - 0.28 " ⎭ =0.44 grain.

Salts and bases, 0.56 grain; consists of lime, magnesia and chlorides.

Water dissolves 3.0 grains; solution, neutral; organic matter burnt off, 1.4 grains; salts soluble in water are lime, magnesia, chlorides and sulphates; salts insoluble in water are magnesia, lime, chlorides, sulphates and silex. Whole amount of salts, 1.6 grains.

Carbonate of ammonia dissolves 13.6 grains, which consist of—

Apocrenic acid, - - -	11.30 grains.
Crenic " - - - - -	0.96 "
Humic " - - - - -	0.14 "
Coal of humus, - - - - -	0.60 "
Extract of humus, - - -	0.60 "
	13.60 "

(C.)

Mr. Boody's Letter.

Long Island, Moultonborough, December 19, 1842.

Dear sir: I address you this line to give you a correct statement of my crop of grain, raised by me in 1842, and also the preparation of the ground for the reception of the seed. In April, 1840, I ploughed 150 rods of green sward. I then hauled on 18 loads of manure from my barn yard, made during the previous winter, being of rather coarse quality. It was spread on the furrows, and the ground was harrowed in the best manner. The ground was then planted with potatoes, in rows about three feet apart, and two and a half feet between hills. The crop therefrom was three hundred bushels of an excellent quality. After harvesting the potatoes, I hauled on 18 loads of manure from the yard, made during the summer, and left it in small heaps till April, 1841. It was then spread and the ground ploughed. The first part of May, the ground was well harrowed, and then planted with corn. The corn came up and looked very promising for a large crop; but the drought came on about the time it was silking, and was so severe that I had but a slight crop—I should think not more than thirty or thirty-five bushels.

In April, 1842, I ploughed the ground as soon as it was fit to work. On the 19th I harrowed it. I then took 1½ bushels of red beard Black Sea wheat and washed it in several waters—then put my grass seed with it and about six quarts of lime that had been air slaked and mixed together. I sowed it and harrowed it in, and then rolled the ground. My crop of wheat from the above 150 rods of ground, was 38½ bushels of a superior quality.

In April, 1841, I ploughed 150 rods of green sward, and put on twenty loads of manure from the heaps at the barn windows, and spread it on the furrows. I then harrowed it in,

and planted it with corn. The first part of May, the corn came up and looked very promising, till the drought came on and injured it so much that I had a very light crop—I should think thirty bushels. In April, 1842, I ploughed the ground and harrowed it. I then took 1½ bushels of tea wheat, and having prepared it in the same manner as I did the Black Sea, I sowed it and harrowed it in and rolled the ground. My crop from the 150 rods of ground was 29½ bushels of the tea wheat of an excellent quality.

In 1840 I seeded down with grass seed one acre of ground, which I sowed with wheat. By reason of the seed not being good, or some other cause that I cannot account for, I did not get any "catch" of grass. I ploughed the stubble in and planted it with potatoes in May, 1841, without using any manure. I had a lighter crop than usual, on account of the drought—the crop was about two hundred bushels. The same was ploughed in the first part of April, 1842.

I ploughed two acres green sward the last of August, 1841. I harrowed it lengthwise of the furrows a few days previous to the 18th of April. On the 18th of April, 1842, I sowed on the 3 acres of ground thus prepared, ten bushels of oats, 20 lbs. clover seed, and 12 quarts of herds grass seed. I then harrowed the ground and rolled it, so that it left the surface very smooth and even for mowing. My crop of oats was 6667 lbs., or 222¼ bushels, allowing 30 lbs. to the bushel. On the swarded land above described, there was not any manure used, and I should think that I did not get more than 10 or 1200 lbs. of hay in 1841 on the two acres. My grass, after harvesting my oats, was very luxuriant, and afforded feed for my cattle in abundance, from so small a piece of ground.

I would here remark that the two first pieces of ground on which I raised my wheat, were supposed to be two acres; but I have found it by an accurate measure to be only one hundred and fifty rods in each piece; which measure I made for the purpose of giving the foregoing information.

Very respectfully,

JOHN S. BOODY.

To. DR. C. T. JACKSON.

(D)

Mr. Tripure's Letter.

Canterbury, Shaker Village, N. H.

DR. CHARLES T. JACKSON:

Esteemed Friend:—It is with pleasure I give you the results of our experiments on the peat bog meadow, because you first gave the stimulus to those exertions, which, I believe, will tend to promote our farming interest in no inconsiderable degree, and which have already shown convincing proofs of the truth of your remark when you first saw the bog, that it was, by far, the best land we owned.

We commenced operations, in good earnest, soon after your visit here in 1841, and, with the expense of about $40, succeeded in lowering the main channel in our meadow about two and one half feet; we then cleared out the old marginal drains so as nearly to surround a small piece, which was ploughed, and left to be exposed to the action of the frost, intended for experiments in cultivation the ensuing season. It should be understood that this was the most barren and, apparently, worthless part of the meadow; indeed it was good for nothing as it then was, for it produced nothing, excepting a few bushes. This plat was planted in the spring of 1842, principally with potatoes, one third of which was manured in the hill with a small quantity of stable manure, one third with one-half pint of unleached ashes to the hill, and one third with no addition whatever. The two first portions produced a handsome crop; the other but very few; the whole required but little labor in hoeing, and we had the pleasure of harvesting from this piece 170 bushels of beautiful roots, which did not cost more hard labor, and not one half the manure that

50 bushels would on our hard upland soil, to say nothing of the time employed in clearing such land of the stones.

We have never measured the land, and cannot tell how much it produced to the acre, but we measured one smaller piece, and found it yielded 300 bushels to the acre; this was manured with ashes only.

But whether the crop be great or small, it was a powerful argument to prove the practicability of rendering the whole meadow productive. Accordingly, the last season we surrounded about seven acres with marginal drains, with sufficient cross drains to lead the water into the main channel; these drains we intend to fill with small stones.

In addition to the trial on the potatoe crop, we tried the experiment on grass, corn and some other vegetables. One small piece was covered with a thin coating of loam, with a small quantity of lime, say 20 loads, of 30 bushels to the load, and 2 casks of lime to the acre. This was sown with clover and red-top seed; both grew luxuriantly, producing full two tons of hay to the acre the first year, but we do not think the clover or the red-top so well suited to this kind of soil as the herds-grass. The tap-root of the clover will not strike down as in common soil; of course it is more liable to be destroyed by the frost—but the herds-grass appears to be the most profitable article we can grow on this kind of soil, and we shall endeavor to introduce it as soon as possible.

The earing of the corn was nearly destroyed by the hail, but its vigorous growth proved, to a demonstration, that the soil was well suited to that crop, and it would yield abundantly when manured with ashes, lime, or any thing that would produce ammonia, such as stable manure, urine and, particularly, any animal substance. But, aside from the grain, the food for stock, arising from this crop, would doubly compensate us for the labor required in its cultivation, provided grass would not grow, which, however, we are gratified to learn, is not the case.

Carrots and other tap-rooted vegetables will not grow to advantage in this soil, from the fact that the top of the soil contains nourishment enough for them; of course they are not under the necessity of striking deep to obtain it. But though many other plants may be made to vegetate well in peat land, yet we are of the opinion that corn, potatoes and grass, and more especially the latter, make the best return for the labor applied in their cultivation, or, at least it is so with regard to our meadow. And now, for the manure heap: this forms a grand point, on which the destiny of the tiller of the earth must and will turn; for a farmer, to render his lands productive, without this all important item, is utterly impossible. And now, after two years' fair trial, we are prepared to say, that, in this part of the country, we should look upon that farm, which has not its peat land in sufficient quantities for the compost heap, as nothing worth; for we have found by experience, that meadow mud, mixed with one-half or one-third of its quantity of stable manure, or one-tenth of animal substance, and suffered to remain in a snug heap for a few months, after which, from one-half bushel to one bushel of recently slacked lime being applied to each load, of 50 bushels, and well mixed and allowed to remain 10 or 15 days, produces a manure more durable in its effects than the same quantity of common stable manure; but it may not, in all cases, produce that immediate luxuriance in vegetation which some of the more stimulating manures would; and hence arises one cause of its rejection. But if any one doubts its efficacy, let him lay off a small plat of ground and annually apply compost made as above, after the rate of 20 loads, of 50 bushels, to the acre, for any successive number of years, and raise what he pleases, and see if that soil does not increase in fertility.

Now this being a well established fact, it seems to open a new era in farming; for the man, having the facility for so doing, and neglecting to convert his 50 loads of manure into 150, is justly deserving of that poverty which idleness always insures.

The advantages of the compost heap are numerous; for every dead animal and all otherwise useless offal, so often seen by the road side, detrimental to the olfactories of travelers, if not to their health, may, by the compost heap, be converted into so many

sources of profit to the judicious husbandman. In fact, we consider our bog, as it is, for compost manure, a treasure, a real bank, where we have no defalcation to dread, and no fear of stopping payment for the next 1000 years, at least.

But one great objection to compost heaps, as here recommended, is the requisite labor in digging them over so much. Now we have a cheaper method by which much of this labor is saved. We form our heap a regular square, say one rod wide and as long as we please, or it may be wider, but this is a convenient shape. The mud being hauled and placed in this shape, from 6 to 12 inches thick, we next cart on the manure of the same thickness of the mud; then comes the peat again: these make the heap of sufficient thickness. Now, with a large plough, this heap may be worked over in a few minutes, and the work done equally well as with a shovel; only care must be taken to have the plough go to the bottom of the heap.

We have not forgotten the carbonate of ammonia which you recommended, and shall endeavor to give it a fair trial the ensuing season, because we are of the opinion that any manure is useful in peat land, in proportion to the ammonia, or other alkali, that it forms, and no further, and should this answer our expectations, its ease of application will be no small account in its favor.

You will probably remember the turnip field, manured with salt, the result of which I promised to send you.

In 1842 we took up a poor piece of worn out pasture land, intending it as a turnip field, and having no other manure to spare but a light coating of leached ashes, the quantity of which was such as to amount to nothing, we concluded to try the effect of salt. Accordingly considerable part of the piece was sown with salt, after the rate of two bushels to the acre; one portion received after the rate of four bushels, and the third none. The difference was plainly perceptible through the season, and on harvesting, one square rod, taken as a specimen of the rest, afforded quite different results; viz., that to which no salt had been applied yielded nothing worth harvesting; that which received 4 bushels was but one remove for the better; while that to which 2 bushels had been sown, produced 4 bushels of beautiful roots. This may not be considered a great crop, but when we take into consideration the poverty of the soil, and the produce of the other two portions on the same piece, it goes to establish two facts—that salt, in some soils, may be a valuable auxiliary manure; but used too abundantly, may be detrimenial to vegetation. But here we wish to be understood, that we do not think that salt is a fertilizer of the soil, but by its stimulating and chemical action on the ingredients of the soil, it converts those substances into food for plants, which, without this addition, would remain insoluble and, of course, useless. But after all that has been or may be said of salt as a manure, we think that whoever suffers his meadow mud to remain undisturbed, while he is paying away his money for salt to enrich his land, will, in process of time, meet with disappointment.

We take this opportunity of tendering to you our sincere thanks for the kindness and liberality you manifested in communicating all the useful information in your power, and wishing you all success in your laudable endeavors to promote the farming interests of the country,

I remain your friend,

WILLIAM TRIPURE.

February 1st, 1843.

(E.)

Through the politeness of one of the Trustees of the Canterbury Society, I am able to offer the following brief

Historical Sketch of the Community of Shakers:

The society generally known by the appellation of Shakers, commenced at Canterbury, N. H., in the year 1782. A few families, owners of the land, together with others of this vicinity, associated together in the same religious faith at the above time; although they remained in a scattered situation and in a separate capacity as it respects property, until the year 1792, at which time these families locating themselves more contiguously to each other, gathered into a social compact or community of interests, consisting at that time of about sixty members. Since that time there has been a general increase of numbers; so that the society now consists of about 280. Since the first gathering of the society there have been about 125 deaths, whose average ages are 53 years. This average seems to argue in favor of habits conducive to health and longevity.

They possess in Canterbury and in the adjacent towns, about 3000 acres of land, all of which they enjoy in common, no one saying that aught of the things which he possesses, is his own; but each and every one enjoying equal rights and privileges, according to their needs and circumstances, without any difference being made on account of what any one brought in or contributed to the joint interest. This joint interest or stock is holden, protected, used and improved by Trustees, (chosen by the Society,) for the use and mutual benefit of members and not for any personal or private use or purpose whatever. Hence the Trustees have no more individual claim to the said joint property than the other members. They pay their proportion of the public taxes and share in all the burdens of government, except the bearing of arms, which they deem incompatible with the precept of the gospel; "If a man smite thee on one cheek, turn the other also;" "Follow peace with all men."

They submit to every ordinance of men in authority, not inconsistent with conscience or duty to God, and in return claim from government that protection and support guarantied to other citizens. For convenience, the society is divided into three large families, each of which manages their own affairs and looks out for its own support.

The village consists of about 100 buildings, among which are a meeting house, 8 dwelling houses, 3 trustees' offices, and numerous shops, granaries, barns, mills, &c. Their privilege for mills is formed by artificial dams and ponds, by means of water conveyed in ditches from two to three miles in length. On a privilege thus obtained, they have two grist mills, two saw mills, clothier's mill, carding mill, two machine mills, also mills for sawing fire wood, coopering, thrashing grain, &c. &c. The Shakers are agriculturalists and mechanics. The products of the garden are important; for in it they raise seeds, herbs, &c., with which the market, to a considerable extent, is supplied.

Their manufactures consist of wooden ware, such as pails, tubs, measures, churns, rakes, dippers, wheels; also, whips, brushes, corn brooms, sieves, and also to a limited extent, useful fancy articles. They keep from 6 to 800 sheep, mostly of the merino breed, which afford them wool for their own use and are likewise a source of small trade amongst them by the manufacture of shirts, drawers, hosiery, &c.

There are fifteen societies of Shakers in the United States, located as follows: Alfred and New Gloucester, Me.; Canterbury and Enfield, N. H.; Shirley, Harvard, Tyringham and Hancock, Mass.; Enfield, Conn.; Watervliet and New Lebanon, N. Y.; Union Village, Watervliet, Ohio; Pleasant Hill and South Union, Ky.

The number of Shakers in the United States is about 6000, all of whom live and hold their property as above described, and are in their usual flourishing condition.

(F.)

Letter of Wm. A. Hayes, Esq.

South Berwick, Me., July 17, 1844.

DOCT. JACKSON:

Dear Sir:—

When you went with me over my farm, you expressed your approbation of its appearance and management. As you request it, I will give you some account of my farming operations; though I fear you will not find so much to approve of, as you did in the appearance of the farm.

In 1816, I purchased the house where I now live, with thirty acres of poor, worn out land. As I had a taste for farming, I soon made that more productive, and as opportunity presented, I enlarged my farm by purchasing adjacent lots, when my neighbors wished to sell as much as I wished to buy, until my farm consisted of one hundred and sixty acres. About one hundred acres lie together, adjacent to my buildings, ten acres of which are wood land, and the remaining ninety are generally improved as a field for the cultivation of grass, although three lots, being a part of the same, consisting severally of six, nine and ten acres, are alternately used as pastures. The remaining lot of sixty acres of rather ordinary land is near the homestead, though not adjoining it, and is used for a home pasture for cows, &c.

Besides this, I purchased, at a low price, a small farm of about seventy acres, lying two miles from my homestead. This farm consisted of land naturally very good, but had become unproductive by neglect and mismanagement. The house on the farm being worthless, I pulled it down and made the whole a pasture for sheep, young cattle, &c. This pasture is now much covered with thrifty trees, suitable for wood and timber.

I never intended to rely on the income of my farm for the support and education of a numerous family, but rather designed it as a source of health, pleasure, and some profit. I have therefore generally devoted only the morning before breakfast and the evening after tea to the farm; and the residue of the day has been generally applied to professional pursuits. Being with the workmen generally at the commencement and close of the day, I could superintend the operations on the farm, without the loss of more time than was useful for relaxation from my office business.

The land which constitutes my present farm, as it came into my possession, was mostly pasture land covered with bushes, and produced very little grass. My course of management has been to render it gradually more productive, without any great outlay of capital at any one time. I endeavored to set such an example of improvement as any farmer of moderate means might safely follow. I will give you some of the details of my farming. To most farmers they will be trite and common, but to some they may be useful.

As the land then yielded nothing, I ploughed up a large tract each year, put on what manure I had, which made but a light dressing, planted but one year with corn or potatoes, and the next year sowed with grain and grass seed. I went over the arable part of my farm in this way, and it all yielded some grass. I then went over it again, ploughed smaller lots and manured more highly, never less than twenty cart loads of fifty bushels each to the acre. I still planted but once, and laid down the land with grain and grass seed the next year. I spread a like quantity of manure on my land whether for corn or potatoes, and besides, for corn, usually put a shovel full of compost manure in each hill. I have practised both ways, ploughing in the manure after spreading on the green sward, and spreading it on the furrow, and cannot tell which is the better mode. When the manure is spread after ploughing, I harrow the ground lengthwise of the furrows; then cross the furrows with a heavy cultivator, made to be drawn by two horses or a yoke of oxen, and thereby the manure will be fully covered and the surface made mellow for cultivation. When the ground is to be sown down to grain and grass, after planting one year, I do not

plough the ground, but pass over it both ways with a heavy cultivator, which thoroughly pulverizes the surface without disturbing the sward. After sowing the grain and a liberal quantity of grass seed and harrowing it in, I roll the ground with a heavy roller. With this management the grass seed always takes well, and the young grass survives even a severe drought. I have not failed of a good crop of grass the first year after laying down, for twenty years. I prefer the southern clover, which though it gives a less crop of hay, is of much better quality. While my object is especially to enrich my land, I plant but once, so that I may plough the land often, and every time I plough, turn under the great quantity of vegetable matter contained in the green sward; but after the farm has become rich, and the crop of corn or potatoes is the object more especially sought for, it is best to plant twice, with corn and potatoes successively, as you will in that way obtain larger crops. I apply all the manure to the land, when planted with hoed crops. When land is planted twice, the manure should be ploughed in the second year, and the land also ploughed for the grain crop. I break up a great portion of my ground in the autumn; not because the land is better for it being done then, but to give opportunity for the other work in the spring, which cannot then so well be dispensed with. I usually plant my corn from the tenth to the twentieth of May, and half of my potatoes before the corn, and half afterwards. The potatoes planted before the corn, are hoed twice; those after the corn but once: the corn is hoed three times. And as I believe clean cultivation in a long run a saving of labor, I cut up all the weeds found on the planted land after haying. I used formerly to sow ruta bagas for my stock, but I have found them, in this climate, an unprofitable crop, and have for many years abandoned their cultivation. Carrots are a very clean and nutritious vegetable, and I have for many years raised several hundred bushels of them annually. I consider it doubtful whether it would not be better, where land is cheap, to abandon the cultivation of corn also, and raise more potatoes. It requires less labor, but more land, to raise a like value in potatoes.

A portion of my farm is a muck swamp on a clay bottom. The muck varies in depth from two feet to a few inches. To drain off the water, I have dug a main drain and cross ditches at right angles with the main ditch, two rods apart, exclusive of the drain. I covered the swamp thus drained with soil, gravel or clay, whichever could be obtained most conveniently. The swamp grass soon died out, and was immediately followed by English grasses, herdsgrass, clover and red top, and yielded a large crop. Every few years a large quantity of soil, muck and vegetable matter settles in the ditches. By cutting and cleaning these ditches every four or five years, and spreading what is taken therefrom over the land, the soil is kept good and highly productive.

My farm, as it came into my possession, produced very little hay. It now yields annually upwards of a hundred tons, and is improving every year. About half of the hay is eaten on the farm, and the other half sold. My principal barn is one hundred and five feet long, and forty-three feet wide, with twenty feet posts. In stowing away hay in the barn, we lay the hay out on each side till the mows meet, thus forming an arch on which is laid a mow of hay extending the whole width of the barn. We also have a stable, 33 by 24 feet, used exclusively for horses, a small barn, 35 by 26 feet, for hay, and another barn used exclusively for grain. Under the barn is a spacious cellar for roots; but a cellar for manure is a desideratum soon to be supplied. When I built my barn, I was derirous to have every thing about it done thoroughly, and therefore unwisely put a close underpinning all around under the barn. I found that the sills and sleepers soon began to rot, by reason of the moisture and confined air, so that to prevent it, I removed the underpinning for a short space between the posts. I placed my barn so that I have yards all around it. It is convenient to have spacious yards for different kinds of stock, and for places of deposit for materials to be converted into manure, in their different stages of decomposition or manufacture.

Besides the large swamp of shoal muck on a clay bottom, which I have converted into the best of grass land, I have within twenty rods of my barn a swamp of a few acres of

muck, ten or fifteen feet deep, resting on white sand. From this I annually, after haying, haul more than a hundred loads of fifty bushels each, and deposit it in yards on the back side and further end of the barn. In these yards, we also place all the potatoe tops, coarse grass, fern and small bushes annually mowed in the pasture, and other coarse materials which would not be fit for use as manure the next spring. No stock go into these yards, except the sheep during the winter. After the cow yards and hog yards are cleared of their contents in the spring for planting, this muck and other materials are carted into the cow yards on the other side and end of the barn, and to the hog yards near by. These yards are several times ploughed or dug over during the summer. To this mass we occasionally add more muck, turf, soil, lime and ashes, so that no unpleasant stench shall arise therefrom. I never use rockweed or kelp in its green state on my farm, but frequently add that to the other materials, which make up the compost manure. A part of this compost is taken out in the autumn, and laid in large heaps on the ground to be planted the next season, and the residue is taken out in the spring, intermixed with the winter manure. The same course is pursued yearly.

My hog stye is seventy feet long and seventeen feet wide. There is an aisle on one side, and seven partitions for hogs on the other. A place for dressing the hogs, and kettle for cooking their food are in the centre. Doors are so placed that the swine may be removed from one apartment to the other, and to the area for dressing them. There is a row of yards on the side of the stye, one for each apartment. The doors leading to these yards are hung at the top, so as to swing either way, and thus the hogs may go in or out at their pleasure, and always have their doors, when desirable, closed after them. These doors should be made of plank or double boards, to render them so heavy that the wind will not keep them open in cold and stormy weather. The hog is proverbially called a dirty animal. This depends very much on his *education*. If he has been *brought up* with dirty habits, he will continue in them, unless great pains are taken to change them. But on the contrary, if he has acquired good habits, he will endure great suffering to avoid a filthy action. Hogs in this land of barren soil are especially valuable for making manure. I could never obtain much advantage from the rooting of well fed swine; but the quantity of urine they discharge is very great and valuable. It is very important that the evacuations of the hog should always be deposited on the manure heap. If they are discharged in the stye or in his nest, they will be principally lost. Now by observing the regular habits of this animal, and taking a little pains, a bad habit in this respect may soon be cured. The confined hog always goes to a wet place to make his evacuations. If then, you wish the hog to change the place for doing this, dig a small hollow place in the manure heap, and keep it wet for a few days by turning in water occasionally; at the same time make the place clean and dry which you desire the hog to abandon. The hog will then probably go to the wet place in the manure yard to make his deposits; but if he should not do so, fasten him out from the stye for a few days, so that he shall be compelled to go to the desired place, keeping the place you wish him to abandon, clean and dry in the mean time, and you will without fail accomplish your object. This to some will appear a low and trifling subject to write about, but the farmer, to thrive, must attend to small concerns. I usually keep ten old hogs on my farm, and pigs to supply their place. They are fed with the waste of the kitchen, dairy, and with boiled roots, apples and some meal.

The most economical part of my establishment for making compost, is a yard at the end of the stable, where the horses' manure is thrown out. This is so located that drains are laid down, made of plank, partly covered and partly open, by means of which the water used in the family washing and the water from the sinks of the house is conveyed through the necessary to the compost heap in this yard. I also here keep a few hogs or pigs, and during the year about fifty loads of manure accumulate.

I formerly kept from 150 to 200 fine wool sheep, and they were profitable. Since wool has fallen in price, I have reduced the sheep to about 50. As there is much less difference than there used to be in the price of fine and coarse wool, and as the lambs of the

Saxony sheep are more likely to die and are of less value to the butcher, I shall enlarge my flock with coarser wool sheep.

About fifteen years since, I began to plough my pasture and sow it with winter rye, without fencing off the ploughed land. The extra feed from the rye with general improvement of the pasture well paid the expense. I afterwards thought I would plough several acres, fence it up and take off two crops, and they would pay the expense. I pursued this plan for several years. By experience I was satisfied that it was bad management. The crops would not pay the expense of cultivation and fencing; and besides, the land was much reduced by taking off the crops. I have since annually ploughed at the most leisure season, several acres in the pasture, sowed it down generally with rye, and always with chaff from the barn or grass seed, and suffered the cattle to go to it in common with the rest of the pasture. Several of my neighbors have pursued this course. The moss, grass, small bushes and droppings of the cattle are turned under, and the pastures are thereby much improved. I can confidently recommend this management to general adoption, where the pastures can be ploughed and the farmer has not a surplus of manure to apply to them.

I have sowed apple seed and therefrom planted an orchard of eight acres. The trees are generally two rods apart each way, and are all engrafted. I make no cider; the waste apples are carefully picked up, boiled and mixed with meal for the hogs. The trees are generally thrifty, bear well, but suffer some for want of more cultivation. I, however, never suffer the orchard to remain long in grass without ploughing.

I generally raise all my young stock; and for work keep four large oxen, and steers to supply their place, and also two horses. The oxen break up the green sward, haul the manure, the hay and fire-wood. The horses plough the old ground, cultivate, harrow and rake hay. The oxen and teamster work out enough to pay a large portion of the labor on the farm.

I have set out many forest trees, and planted shrubbery about my grounds, and make gradual but slow improvements in every part of the farm.

My farm extends over a high hill, from low lands on each side. Both ends abound in clay. I have done something by hauling clay upon sand and sand upon clay, and have found it advantageous. Almost every farm abounds in means of improvement, and these means are developing themselves continually. I have done very little compared with what may be done by those who shall succeed me. Much of my farm may be improved by under-draining, at which I have done nothing.

Every lot on the farm except the orchard, is abundantly supplied with ever-living water. We have a well for the house and another for the barn yard. As our wells are much used, I was desirous of having the most perfect pumps for drawing water. As a caution to others, I would remark that I purchased several kinds of patent pumps, which were highly recommended: I found they soon got out of order, were difficult to repair, and I found it necessary to abandon them all. I then went to my own wood lot, cut logs for pumps so large that when hewed down to a proper size, all the sap would be taken off, sent them to Portsmouth and had them made by an experienced ship pump maker, in the good old fashioned manner. These are the best pumps. Mine have been in use for years, and have required very few repairs. A large rock over each well supplies the place of a platform.

The income of the farm, besides supplying a large family, is derived principally from the hay, beef, pork, wool, apples, potatoes and ox work. I take in cattle to pasture, to pay the interest on the cost of the out pasture.

I have thus given you a general account of my farming. I wish you to understand that I do not consider any thing about my farm as deserving particular notice from being well done. On the contrary I see great room for improvement in every thing. You are at liberty to throw these sheets aside as waste paper, or make any other use of them you may think proper.

I am, dear sir,
with much respect, yours, &c.,
WM. A. HAYES.

(G)

Mr. Tripure's Letter.

Canterbury, N. H., July 4th, 1843.

DR. C. T. JACKSON—

In answer to your several inquiries concerning the manufacturing of sugar from the maple, we would state that we have not been sufficiently accurate in our experiments to be very nice in those several particulars mentioned, but can give you some general outlines of our operations. Our trees would average something like 14 inches in diameter; of this size we tapped 430 in the year 1842, from which we obtained 302 bbls. sap, making 2,150 lbs. sugar; but it must be recollected, these were open land trees, which will yield, upon an average, 1-8 more sugar than forest trees, which will produce about 4 lbs. raw sugar the season—this we should consider a fair estimate for forest trees of one foot in diameter, taking one season with another, though it appears to be an essentially different result from that afforded by the sap we sent you; but for so wide a difference I can give no satisfactory reason.

In relation to tapping trees, I would remark that the tree may be perforated to the colored wood, although we obtain near one-third more sap in the season by boring about two inches at first, and after the flow of sap begins to abate, as it generally will in 10 or 15 days, to remove the tap and go an inch or more deeper.

As it respects the quantity of sap obtained from trees of given diameters, it would be difficult to state it, for some trees of the same diameter with others will yield double the quantity of sap; indeed I have known trees of one foot to yield 30 quarts of good sap in 24 hours.

You wish to know how many tap holes a tree will admit of without killing it—this question I cannot answer; but I once inserted 24 taps, and did not succeed in killing the tree. As a general rule, two taps are sufficient for one tree, unless it be of large size, or branched near the ground, in which case both branches must be tapped as much as though they were two distinct trees.

In your estimate I think you have assumed too great a quantity of sugar for the sap, although the quantity of sap assumed is a fair estimate; for we never have made one-third of a pound of sugar from a gallon of sap, nor do we think it can be done in the ordinary way. But it would be fair to state 7 lbs. to the bbl., of 30 gallons, or 4 lbs. the tree for forest trees, and 2 men and a boy would tend 1000 trees, making 4000 lbs. raw sugar; some seasons they would make more and some less; and, at this rate, it would be profitable business, especially as it is made that season of the year when farmers have but little else to attend to.

In relation to the buckets you mention, an old sugar maker would manufacture his own troughs on the spot in a little more time than it would require to make the bargain with the cooper, although the buckets would be easier to handle.

Your ideas in relation to the operation are correct, and we look forward with pleasing anticipation to the day when they will be carried out in full.

In haste, I remain your friend,

WILLIAM TRIPURE.

This letter was received in reply to one from me, detailing some researches which I had made on samples of recent maple sap, sent to me by the community of Shakers at Canterbury, and the information contained, although of a private nature, is of so much value, and is characterized by the concientious accuracy so general among the Shakers, that I deem it worthy of public attention. In my processes for making maple sugar, no molasses was formed, hence my method gave a much larger proportion of sugar than is obtained by those ordinarily pursued.

The following is a letter published in the Boston Cultivator, and since it may interest the citizens of the sugar regions of New Hampshire, it is extracted for this Report:

MAPLE SUGAR.

Messrs. Editors: I beg leave to communicate, for insertion in your paper, the results of some researches which I have made on the manufacture of maple sugar; having been much interested in promoting this branch of New England industry, and being satisfied that, if pursued with skill, it cannot fail to prove profitable to the people inhabiting inland towns where the sugar maple abounds.

It is well known to you, without doubt, that the northern parts of Maine, New Hampshire, Vermont and New York have dense forests of the sugar maple, and, at present, only very rude processes are made use of in preparing the sugar for market, so that it is too generally acid and deliquescent, besides being charged with salts of the oxide of iron; insomuch that it ordinarily strikes a black color with tea. To remedy these difficulties was the object of my researches; while at the same time I was engaged in ascertaining the true composition of the sap, with a view to the theory of vegetable nutrition.

I received several gallons of freshly drawn maple sap from Northampton, Warner and Canterbury, and made analyses of each lot, separating the acids, salts and the sugar. I also analyzed the sap of the yellow and white birch, which do not give any crystalizable sugar, but an astrigent molasses.

I shall now communicate to you the process by which I manufactured the sugar maple sap received from the Shakers of Canterbury, who collected it with care in a clear glass demijohn, and sent it forthwith, so that it came to me without any change of composition, the weather being cold at the time. The evaporation was carried on in glass vessels until the sap was reduced to about one-eighth its original bulk, and then it was treated with a sufficient quantity of clear lime water to render it neutral, and the evaporation was completed in a shallow porcelain basin. The result was, that a beautiful yellow granular sugar was obtained, from which not a single drop of molasses drained, and it did not deliquesce by exposure to the air. Another lot of the sap, reduced to sugar, without lime water, granulated, but not so well, and was sour to the taste, and deliquesced by exposure, and gave a considerable quantity of molasses.

Having studied the nature of the peculiar acid of the maple, I found that its combinations with lime were excessively soluble in alcohol, so that the yellow sugar first described could be rendered white in a few minutes, by placing it in an inverted cone open at the bottom, and pouring a small quantity of alcohol upon it, and allowing it to filtrate through the sugar. The whitened sugar was then taken and re-dissolved in boiling water and crystalized, by which all the alcoholic flavor was entirely removed, and a perfectly fine crystalized and pure sugar resulted. Now, in the large way, I advise the following method of manufacturing maple sugar. Obtain several large copper or brass kettles, and set them up in a row, either by tripods with iron rings, or by hanging them on a cross bar, clean them well, then collect the sap in buckets, if possible, so that but little rain water will be mixed with the sap, and take care not to have any dead leaves in it. For every gallon of the maple sap *add one measured ounce* of clear lime water, pass the sap into the first kettle and evaporate; then, when it is reduced to about one-half, dip it out into the second kettle, and skim it each time; then into the next, and so on until it has reached the last, where it is reduced to syrup, and then may be thrown into a trough, and granulated by beating it up with an oar.

As soon as the first kettle is nearly empty, pour in a new lot of the sap, and so continue working it forward exactly after the manner of the West India sugar boilers. The crude sugar may be refined subsequently, or at the time of casting it into the cones made of sheet iron, well painted with white lead and boiled linseed oil, and thoroughly dried, so that no paint may come off. These cones are to be stopped at first, until the sugar is cold; then remove the stopper, and pour on the base of the cone a quantity of strong

whiskey, or fourth proof rum. Allow this to filtrate through, until the sugar is white; dry the loaf, and re-dissolve it in boiling hot water, and evaporate it until it becomes dense enough to crystalize. Now pour it into the cones again, and let it harden. If any color remains, pour a saturated solution of refined white sugar on the base of the cone, and this syrup will remove all traces of color from the loaf.

One gallon of pasture maple sap yielded 3,451 grains of pure sugar. One gallon of the juice of the sugar cane yields, on an average, in Jamaica, 7,000 grains of sugar. Hence it will appear that maple sap is very nearly half as sweet as cane juice; and since the maple requires no outlay for its cultvation, and the process may be carried on when there is little else to be done, the manufacture of maple sugar is destined to become an important department of rural economy. It is well known, by the report on the statistics of the United States, that Vermont ranks next to Louisiana as a sugar State, producing, (if I recollect correctly,) 6,000,000 of pounds in some seasons, though the business is now carried on in a very rude way, without any apparatus, and with no great chemical skill; so that only a very impure kind of sugar is made, which, on account of its peculiar flavor, has not found its way into common use, for sweetening tea and coffee. It would appear worth while, then, to improve this manufacture, and to make the maple sugar equal to any now in use. This can be readily accomplished, if the farmers in the back country will study the process of sugar making; for cane and maple sugar are, when pure, absolutely identical.

It should be remarked, that forest maples do not produce so much sugar as those grown in open fields or in groves, where they have more light, the underbrush being cleared away.

In Farmington, on the Sandy river, in Maine, I have seen a very fine grove of maples but 30 years old, which produced a large yield of very good sugar. A man and two boys made 1,500 lbs. of sugar from the sap of these trees in a single sugar season. The sap was boiled down in potash kettles, which were scoured bright with vinegar and sand. The sugar was of a fine yellow color, and well crystalized. It was drained of its molasses in casks, with a false bottom, perforated with small holes—the cask having a hole bored at the bottom, with a tow plug placed loosely in it, to conduct off the molasses. This method is a good one, but the sap ought to be limed in boiling, as I have described; then it will not attack the iron or copper boilers. The latter metal must not be used with acid syrup; for copper salts are poisonous.

Those who fear to trust alcohol on their premises, may content themselves with the use of lime water to neutralize the acid, and clarify the syrup with eggs or skim milk. Then granulate the raw sugar as usual. To refine it without alcohol, it may be re-melted, cast into cones, drained, and then clayed; or, still better, refined by the displacement of the molasses, by means of a saturated solution of loaf sugar poured on the base of the cone, after removal of the plug from its apex. Although this process does not give so white a sugar, I should prefer it to any risk of an improper use of alcohol; and it has the advantage of giving a much better molasses, which will do for family use; whereas the rum and molasses is a vile compound, unfit for any use but distilling or for making vinegar.

Any portion of the above remarks you may deem interesting to the public, you are at liberty to publish. Yours, respectfully,

C. T. JACKSON.

Boston, 1844.

P. S. Mr. Moses Whicher of Benton, N. H., states that he makes from 1,500 to 3,000 lbs. of maple sugar per annum, and employs but three persons in the work. This is one instance among many of the profitable manufacture of sugar in the northern parts of New Hampshire.

H.

ENDOSMOSE AND EXOSMOSE.

"When two liquids of different densities or chemical composition are separated by a membraneous diaphragm, two currents of unequal force pass through the membrane in opposite directions. From this it results that the mass of liquid accumulates gradually in that compartment towards which the strongest current is directed."

"The current of introduction is called Endosmose, and that of expulsion Exosmose, these terms being derived from the Greek, signifying internal impulse and external, or outward impulse."

M. H. Dutrochet, who first discovered these curious laws, applies them to the explanation of the absorption of liquids by the spongeoles of plants, and the ascent of the sap through their diaphragms and cellular tissue, as also to the exudation from the rootlets.

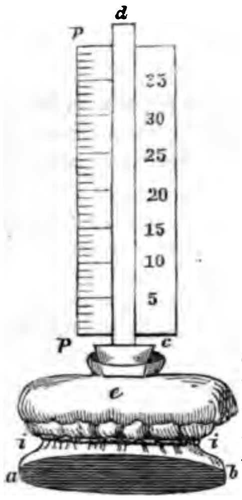
A similar transmission of gaseous matters through membranes is also well known to chemists, and was admirably applied to the explanation of the chemical phenomena of respiration by M. Majendie.

It is very easy to demonstrate the facts on which these theories rest, by experiments, and in a few hours any one may convince himself that no membrane will keep either liquids or gases from commingling. It will also be observed that this commingling is not prevented by the laws of gravitation, for a heavy gas will rise and mix with a light kind of gas placed above it, and the converse will also take place with liquids. It is the result of attractions quite independent of gravitation, which effects ordinary filtration, and of capillary attraction, which causes liquids to rise to a limited height in very small tubes. It explains the universal circulation of liquids in plants, as well as the ascent of the sap to the tops of the tallest trees; for, instead of being obstructions, each thin diaphragm, that lies across a sap vessel, and even the cellular tissue, which makes up the principal part of the structure of a stem, serve as so many endosmomic powers to aid in the circulation of the sap, and in carrying it upward in opposition to the laws of gravitation. It is also proved by experiments, that the rootlets of plants take up any liquids that surround them, and, consequently, the soluble manures must necessarily be absorbed by plants; and since those liquids, which are convertible by the action of the vegetable economy, are found to undergo changes the moment they enter the circulation, it will appear that vegetables possess the power of digestion and assimilation, by which crude organic matter is reduced to all the varied forms and combinations that are presented by the myriads of different species of plants, which, directly or indirectly, nourish all animated creatures, and embellish the surface of the globe.

The phenomena of endosmose are so curious, that I have deemed it instructive to lay before the agricultural community this brief account of the explanation it affords of some of the mysteries of vegetable economy, and since many may feel disposed to assure themselves of the fact, that it is an easy and practicable experiment to make water run upwards, I present the following sketch of Dutrochet's Endosmometer, an instrument with which I have experimented, and verified the statements of its inventor in all essential particulars.

Those who are desirous of reading the original work on this subject, are referred to the *Nouvelles Recherches Sur L'Endosmose et L'Exosmose*, Par M. Dutrochet. Paris, 1828.

The following wood cut represents an Endosmometer, and it is easy for any one to construct such an instrument, a tubulated cupping glass and a small glass tube, being all that are required, besides a perforated tin plate, and a piece of goldbeater's skin or bladder.



a, b. A piece of bladder tied over the orifice of the glass receiver by a waxed silk at *i, i.*

e. Receiver.

d. Glass tube open at both ends and inserted into a perforated cork, *c.*

p, p. Scale of inches to measure the rise of liquid in the tube.

A plate of metal, perforated with numerous holes, is placed against the membrane at *a, b,* to prevent its bulging out or yielding to the liquid within the receiver. A stout piece of canvass tied over the membrane, answers equally well.

In experimenting with this instrument, remove the stopper and pour into the receiver any fluid whose endosmomic properties are to be tried; for instance, sugar or gum dissolved in water. Replace the stopper and tube, and the liquid will rise as the stopper is pressed in, to near the zero of the scale. Now place the apparatus in a large tumbler of water, and see that the liquids inside and outside are at the same level, when it is evident there can be no unequal pressure on the membrane. A few moments after immersion, the liquid will begin to rise in the tube, and will continue to ascend for days, until it finally overflows at the top of the tube. It is stated by Dutrochet that the force of the ascending column is equal to the pressure of 28 French inches of mercury, or about 14 pounds to the inch. Hence it is evident that if the membrane did not undergo decomposition, the liquid in the tube would rise to the height of 29 or 30 feet.

By experiments on grape vines, it has been ascertained that the sap is poured out at the cut extremity of the vine, with sufficient force to raise a column of mercury to the height of 28 inches. And since there can be no such thing as capillary attraction, beyond the cut extremity of the vine, it is evident that the sap rises by a propelling force, or *vis a tergo,* as in the endosmometer.

Exosmose is feeble in comparison with endosmose; for there is but little of the contents of the receiver extravasated into the liquid around it; but that there is a great difference in this respect in different liquids, some passing out with considerable rapidity, is proved by testing the surrounding water.

Chemical decomposition of the membrane, even before any perforation takes place in it, stops endosmosis, and the liquid which had ascended in the tube, filters slowly out again. A few drops of sulphydrate of ammonia will produce the same effect. It is not necessary that the liquid in the endosmometer should be denser than the surrounding water; for alcohol will produce rapid endosmosis, although it is much lighter than water.

How far the facts discovered by Dutrochet will prove applicable to the explanation of the phenomena of vegetation is yet unknown; but it is probable that much light may be shed by his researches, if applied to the investigation of the absorption of fluids by plants, and perhaps the ascent of the sap in the spring is partly due to the density of the liquids in the vessels of plants; and it may be that we shall obtain an insight into the kinds and densities of fluids most proper for absorption.

It may be that nature has rendered the organic matters of soils but slightly soluble in reference to their absorption, and there may be limits beyond which it would prove fatal to vegetation to render the organic matters more soluble. The same may be true with regard to saline manures. This subject has not attracted so much attention as it appears to merit, and many experiments should be made on plants with liquids of known endosmomic powers.

GLOSSARY.

Explanation of such scientific words and technical terms, as are not fully defined in this Report.

The reader is supposed to have access to elementary works on Mineralogy, and is referred to them for a more full description of some of the minerals, and to elementary treatises on Chemistry for details concerning chemical combinations.

ABRASION, wearing away by friction of hard bodies.

ALLOY, a combination of metals made by melting them together.

AMORPHOUS, without any regular crystaline form.

ALTAR OF A REVERBERATORY FURNACE, a low wall which rises from the floor or sole of the furnace in front of the fire, over which the flame passes. It is sometimes called the wind wall.

ANHYDROUS, means without water. An anhydrous mineral is one that does not contain any water.

APOCRENIC ACID, one of the new acids first discovered in the waters of Porla Spring by Berzelius. Its name signifies *from the crenic*, as it is always found with that acid. It is one of the constant ingredients of the organic matter, or mould of soils, and is an active fertilizing agent, being highly charged with nitrogen. It is found combined with peroxide of iron, forming bog iron ore. Its combinations with bases are called apocrenates. Some of them are highly soluble: *e. g.*, apocrenates of the alkalies, potash, soda and ammonia; others are difficultly soluble: *e. g.*, apocrenates of lime, alumina, manganese and peroxide of iron. Alkalies decompose all the insoluble apocrenates, and form, with the acid, fertilizing manures.

ARGENTIFEROUS, bearing or containing silver.

ARGILLACEOUS, clayey or made up of clay.

ASSAYING, separating a metal from an ore. It differs from analyzing, inasmuch as the latter operation determines the nature and proportions of all the ingredients in the ore, while the assay is made, with a view only to obtaining the metal in the state in which it is usually separated in the furnace.

AQUEOUS, watery or from water.

BASALT, a black rock of ancient volcanic origin, produced like lavas, by fiery fusion, and elevated like the trap rocks, through long rents in the overlying rocks.

BASE, an electro positive element of any combination: for instance, potash is the base of sulphate, carbonate or silicate of potash.

BED, a layer of mineral matter which is included between the strata of rocks, and is parallel with their layers.

BLENDE, a shining ore. Sulphuret of zinc is generally known to mineralogists under this name.

Blowpipe, a conical tube used for urging the flame of a lamp by the blast of air.

Botryoidal, like a bunch of grapes, a common form of hæmatite iron ore.

Boulders, loose rounded stones, such as are sometimes called "cobble stones."

Brecciated, rocks made up of angular fragments, as if the rock had been crushed and its fragments re-cemented.

Brasqued Crucible, a crucible lined with charcoal or lampblack, and used for the reduction of oxides of metals to the metallic state. The crucible is prepared by ramming it full of lampblack or charcoal, and then excavating a portion of its contents and polishing the lining with a burnisher.

Carbonate, a combination of carbonic acid, (consisting of carbon and oxygen,) with a base.

Calamine, carbonate of zinc.

Chalybeate water, any water charged with salts of iron. Most chalybeate springs contain the carbonate and crenate of oxide of iron.

Chert, a white stone consisting of silex, lime and clay.

Cleavage, the splitting of a crystal parallel to its natural joints, so as to discover its primary form or nucleus.

Crenic Acid, a new organic acid found in all soils and in many mineral waters, and in the juices of plants. It was first discovered in the Porla Spring by Berzelius, and was named by him *crenic acid*, from the Greek word signifying a fountain or spring. It abounds more in subsoils than on the surface, owing to the solubility of some of its combinations, particularly those with lime and the alkalies. It possesses highly fertilizing properties, when neutralized by bases forming soluble salts. Crenates are combinations of crenic acid with bases.

Cupel, a shallow dish, or cup, made of finely pulverized burnt bones, and used for separation of silver from lead and other metals that are capable of oxidation at a red heat. The cupels used by chemists are made of fine particles of the ground bone ash, and are obtained by washing them out from the coarser particles by water and pouring into a filter, which allows the water to pass through, but retains the fine bone ash, which is then quite plastic, and is capable of being made into the forms desired. Large cupels, such as are used in furnaces, are made of a mixture of fern ashes and bone ash, and are moulded into form in an iron ring or hoop. When used, the cupel absorbs the melted oxide of lead as fast as it is formed, and leaves a bright globule of pure silver on the surface.

Decomposition, separation of the ingredients of a body by natural or artificial means.

Detritus, the separated fragments and fine particles worn off from the rocks, or derived from their disintegration.

Dichroism, having two different colors, according to the direction in which the light traverses a crystal.

Disrupted, broken through by subterranean upward movement.

Disintegration, separation of the integrant minerals of a rock; for instance, the quartz, felspar and mica of granite. It differs from decomposition, since the minerals themselves are not necessarily changed in composition.

Dip, the depression of the strata of rock from the horizon.

Drift, the loose materials constituting the surface of the earth, sand, gravel and boulders which have been moved by currents of water in ancient times.

Drift scratches, or diluvial scratches and grooves, are the marks on the surface of solid ledges of rocks, and are supposed to have been produced by the grinding action of masses of soil, gravel and rocks, during the movement above mentioned.

Drift, or level, a horizontal gallery made in mining.

Dyke, a vertical sheet of rock that has been injected into a fissure in other pre-existant rocks, by the action of ancient volcanic power.

Endosmometer, an instrument used in ascertaining the relative powers of absorption through membranes. (See article Endosmose and Exosmose in Appendix to Agricultural Geology and Chemistry, p. 363.)

Epigene, (produced upon;) a rock produced by layers deposited on the surface is called epigene: *e. g.*, all the rocks deposited as a sediment from water.

Epidotic, containing the mineral called epidote.

Elvans, dykes of porphyry.

Eruptive, rocks which have been thrown up in a molten state by igneous agency, such as the trap, basalt, granite, sienite and porphyry.

Escarpment, a very steep mountain side, almost or quite inaccessible.

Fissile, capable of being separated into thin sheets: *e. g.*, roofing slate.

Flux, substances added to the ores of metals in the furnace, to make them flow more easily. Fluxes are also used in assaying ores in the crucible and in the examination of minerals before the blowpipe.

Fluoriferous, containing fluorine, an elementary principle found in fluor spar, mica and some other minerals.

Foundry, a furnace used for re-melting metals and casting them into various forms.

Fossil, originally meant any mineral dug from the earth, but now is restricted to petrefactions of organic remains of animals and plants—rocks containing organic remains are called fossiliferous.

Galena, an ore of lead composed of sulphur and lead.

Gangue, the rock which immediately encloses the mineral.

Geine, an old name for the organic matters of soils. It was first given by Berzelius, and was subsequently abandoned by him as improper; for it was discovered that the organic matters consisted of a variable mixture of several peculiar acids and neutral substances, the acids being in part combined with bases of various kinds. Crenic, apocrenic, and humic acids with humin, extract of humus and a new extract not yet described and named, are the principal proximate principles contained in the organic matter of soils. Geine was regarded as a combination of carbon, hydrogen and oxygen, an error of considerable importance in the science of agriculture, and one that has been removed by more accurate researches, which have proved that nitrogen enters largely into the composition of two of the new acids and one of the extracts. The combinations of the new acids shed much light on scientific and practical agriculture.

Geognostic, knowledge of the earth. The term is used to define the relations of known rocks, and is more positive than the word geological, which admits of theoretical views.

Graphic granite, a kind of granite in which the base consists of felspar, and the quartz is disposed in such a manner in its laminæ as to represent letters like those of the Arabic or Hebrew languages.

Granular, composed of fine grains: *e. g.*, granular quartz, granular galena, &c.

Granulate, the separation of metals in the form of grains, by pouring the melted metal through some space in the air, or by throwing it into water from a height. Leaden shot are made by this operation.

Hæmatite, a brown or red ore of iron, consisting mostly of the peroxide of iron.

Hemitropic, crystals that appear as if composed of two halves of a crystal turned partly round and united. Examples of this structure may be often found in felspar and oxide of tin crystals.

Humerus, the arm bone.

Humic acid, one of the acids contained in the mould or organic matters of the soil. It is derived from the decomposition of vegetable substances in moist soil, and is composed of carbon, hydrogen and oxygen. Many of its combinations with bases are soluble in water; hence it is found in the subsoil combined with lime, iron, potash, soda and ammonia. Its combinations with bases are called humates.

Hypogene, produced from below. Rocks which have originated in this manner are all of igneous origin, and were protruded through the superincumbent strata.

Igneous, produced by fire: ancient volcanic rocks.

In place, ledges of rocks that are where they were originally formed, or in the situation which they have occupied from the earliest periods of geological time.

Kaolin, a kind of porcelain clay derived from decomposed felspar.

Kyanite, a blue mineral occurring in thin blades and prismatic crystals. See books on mineralogy.

Lode, the contents of a vein—a miner's term.

Lithomage, a kind of porcelain clay very smooth to the feel.

Macles, hollow crystals filled with a portion of the rock in which they occur. This term is also applied by some mineralogists to hemitropic crystals.

Manganesian, containing oxide of manganese.

Metalloid, like metals, but wanting some of their properties.

Micaceous, like mica, composed of brilliant spangles or thin plates.

Muffles, thin ovens made of refractory clay and used in metallurgy for heating ores or metals while they are fully exposed to a current of air, without any danger of contact with the fuel. They are employed in oxidating metals, roasting sulphurets and arsenical ores, to deprive them of sulphur and arsenic; also for cupelling lead and silver ores and for burning organic matters from soils in analysis.

Nodules, small rounded masses of minerals.

Organic, derived from organized beings, animals or vegetables.

Oxides, combinations of oxygen or vital air with metals or other substances, which are electro-positive in relation to it.

Outcropping, coming out to the surface: *e. g.*, the edges of strata of rocks where they come out of the ground.

Peat, partially decomposed or disorganized vegetable matter, arising mostly from the decomposition of sphagneous mosses, dead leaves and the trunks of trees. The mosses give origin to the principal part of it and then partially decayed stems bind the peat together, so that it is kept whole in the process of drying it for fuel. It grows so long as the bog is kept moist enough for the mosses to flourish; for as their stems grow, their roots decay and add continually new matter to the bog. It is in its natural state generally acid, and requires an admixture of basic matters before it will serve for manure or for cultivation.

Pot holes, rounded, well shaped cavities excavated in solid rocks, by the grinding of loose stones moved by a waterfall.

Porphyry, a rock composed of compact or uncrystalized felspar with small rectangular crystals of felspar imbedded in it. Rocks that have a similar structure are called porphyritic.

Pyrites, a name originally signifying firestone, as the bisulphuret of iron was used formerly for striking fire with steel. It is now applied to some other sulphurets which cannot be used for that purpose: *e. g.*, copper pyrites, which is too soft.

Rable, an iron scraper serving for a rake in removing scoriæ from the surface of melted metal in a reverberatory furnace. It has generally an iron handle ten or fifteen feet in length. The iron scraper is about a foot long and from four to six inches wide.

Radius, one of the bones of the fore arm—in man, the one on that side next to the thumb. It turns on the ulna, whence its name.

Re-agents, chemical substances used in analysis of minerals.

Reduction, the conversion of an oxide of a metal to its metallic state. The term is also used generally, to express the separation of substances from the oxygen with which they are combined by combustion.

Regulus, an old term for purified metal.

Reverberatory, a kind of furnace in which the flame is caused to play against the top and turn back upon the hearth or sole, so as to oxidate, melt or reduce an ore or metal, according to the amount of air admitted.

Retort, a vessel of glass, earthern ware, fireclay or iron, rounded at the bottom and having the neck turned over on one side. Fireclay retorts are used for distillation and sublimation of metals. Those made of glass are used for distillation of liquids.

Strata, layers of rock which are parallel with each other.

Seggregated, separated and collected together—mineral matters are thus frequently separated from others and from the mass of the rock and form groups by themselves.

Sulphuret, a combination of sulphur with some other element: *e. g.*, sulphuret of iron is a combination of sulphur and metallic iron.

Sulphate, a combination of sulphuric acid, consisting of sulphur and oxygen, with some base : for instance, with oxide of iron, forming sulphate of oxide of iron.

Silicate, a combination of silex or silicic acid, with a base : *e. g.*, silicate of lime, silicate of potash, &c., in which the lime and the potash are bases or electro-positive substances.

Scintillation, burning with brilliant sparks : *e. g.*, white hot iron when exposed to a current of air.

Slag, a kind of coarse glass made by fluxing ores of metals. It is most frequently composed of silex, alumina, lime and a portion of oxide of the metal wrought in the furnace.

Smelting, reducing ores to metals in furnaces.

Sole of a Reverberatory Furnace, the floor or hearth of the furnace.

Speculum, a mirror made of metal highly polished, used in astronomical telescopes.

Stamping, pounding an ore by means of heavy pestles of iron arranged in a battery and moved by machinery. It is an operation required in preparing ores for the washing table.

Striæ, fine marks or grooves.

Sublimed, a solid raised by heat in vapor, and condensed again by cold.

Supernatant, that portion of a fluid which floats on top.

Swamp Muck, is partially decomposed vegetable matter, resembling peat, but differing from it as to origin and texture, it having resulted mostly from the disorganization and decay of leaves and trunks of dead trees. It is not fibrous, and is more charged with earthy matter than peat, and it yields more soluble matter to alkalies. It generally contains from 60 to 80 per cent. of vegetable matter, and is valuable in making compost manure.

Tap hole, the orifice from whence the metal is drawn from a furnace.

Trende, course or direction of the edges of strata of rocks.

Tuyeres, the tubes or holes through which the blast pipe blows in a furnace or forge.

ULNA, one of the bones of the fore arm—in man, the bone on the side of the arm next to the little finger.

VEIN, a crevice in the rocks filled with ores of metals or other minerals, and generally traversing the strata of stratified rocks.

VOLCANO, a conical mountain or orifice in the rocks, from whence the molten lavas of the interior of the globe are forced out during eruptions, accompanied by vast quantities of steam, acid, vapours and salts.

WASHING, separation of pulverized minerals by water, the light particles being washed away and the heavy ones left.

INDEX.

LIST OF PLATES ACCOMPANYING THIS REPORT.

ERRATA.

The reader is requested to correct the pages of this Report with his pen in those places where the typographical or other errors affect the sense of the work.

Page 2,	line 15 from	bottom of page,	for *geognistic* read *geognostic*.
" 3,	" 11 "	top	" *flank* read *flank*,
" 7,	" 21 "	bottom	" *these* read *their*.
" 8,	" 14 "	top	" *familtar* read *familiar*.
" 10,	" 23 "	bottom	" *chemistry* read *Chemistry*.
" 16,	" 19 & 28 from	top	" *cardoc* read *caradoc*.
" 16,	" 14 & 23	"	" *landelio* read *landeilo*.
" 16,	" 7 from	top	" *Vanuexen* read *Vanuxem*.
" 18,	" 8 "	"	" *Murchision's* read *Murchison's*.
" 20,	" 10 "	"	" *dicolyledonous* read *dicotyledonous*.
" 21,	" 11 "	"	" *callad* read *called*.
" 21,	" 12 "	"	" *Icthyosaurus* read *Ichthyosaurus*.
" 21,	" 16 "	bottom	" *petrefied* read *petrified*.
" 24,	" 15 "	bottom	" *Switzerland* read *Spitzbergen*.
" 38,	" 16 "	top	" in the formula for *F* read *A*.
" 49,	" 17 "	"	" *transhipment* read *transshipment*.
" 51,	" 13 "	"	" *felsparthic* read *felspathic*.
" 54,	" 14 "	bottom	" *argillaceons* read *argillaceous*.
" 56,	" 4 "	"	" *flourine* read *fluorine*.
" 56,	" 6 "	"	" " "
" 62,	" 18 "	top	" *John Durkee* read *Maj. Topliff*.
" 68,	" 4 "	"	" *far removed* read *remote*.
" 71,	" 3 "	bottom	" *uva ursa* read *uva ursi*.
" 80,	" 5 "	"	" *discoverry* read *discovery*.
" 96,	" 4 "	"	" *recticulated* read *reticulated*.
" 105,	" 13 "	"	" *eliptical* read *elliptical*.
" 106,	" 3 "	"	" *pinacles* read *pinnacles*.
" 109,	" 16 "	top	" *Erhenberg* read *Ehrenberg*.
" 109,	" 19 "	"	" *caleaceous* read *calcareous*.
" 109,	" 20 "	"	" *silicia* read *silica*.
" 115,	" 19 "	"	" *Ingalls* read *Ruggles*.
" 116,	" 7 "	"	" *irridescent* read *iridescent*.
" 124,	" 16 "	bottom	" *calcereous* read *calcareous*.
" 136,	" 12 "	top	" *silicia* read *silica*.
" 155,	" 11 "	"	" *Philips* read *Phillips*.
" 188,	" 5 "	"	" replace the period by a comma, and put *h* for *H* in *having*.
" 190,	" 22 "	"	" for *effervescence* read *efflorescence*.
" 193,	" 10 "	bottom	" after *crucible* insert *and the*.
" 194,	" 4 "	"	" strike out the words, *for transportation*.
" 208,	" 19 "	top	" for *zinc or blende ore* read *zinc ore or blende*.
" 211,	" 13 "	bottom	" for *clearly* read *cleanly*.
" 216,	" 22 "	top	" after locality, for *was* read *were*.
" 216,	" 23 "	"	" after *This* insert the word *granular*.
" 216,	" 9 "	bottom	" for *assimilated* read *associated*.
" 217,	" 9 "	top	" in *cupellings*, omit *s*.
" 219,	" 3 "	bottom	" for *pale* read *full*.
" 220,	" 5 "	top	" for *Anstel* read *Austel*.
" 222,	" 22 "	bottom	" for *a lined* read *an air*.
" 223,	" 21 "	"	" for *wash tin* read *washed tin*.
" 223,	" 19 "	"	" for *contains* read *contained*.
" 226,	" 9 "	"	" for *increase* read *increases*.
" 228,	" 6 "	top	" after *subsequently*, strike out *be*.
" 229,	" 5 "	"	" for *ever* read *even*.
" 233,	" 19 "	bottom	" for *arsenious acids* read *arsenious acid*.
" 235,	" 5 "	top	" for *smelt* read *smalt*.
" 244,	" 12 "	bottom	" strike out the word *turnips*.
" 247,	" 17 "	top	" for *I. I. Berzelius* read *J. J. Berzelius*.
" 254,	" 2 "	"	" for 17 read 15.
" 254,	" 19 "	bottom	" for *obtained* read *attained*.
" 255,	" 6 "	top	" after 16.2 insert *grains of*.
" 257,	" 10 "	bottom	" for *concoctions* read *concretions*.
" 258,	" 8 "	"	" for *extinction* read *extrication*.
" 260,	" 23 "	"	" for *lime* read *zeine*.
" 272,	" 1 at	top	" for *copper* read *coffee*.
" 282,	" 1 "	"	" for *Eri* read *Evi*.
" 282,	" 1 "	bottom	
" 316,	1st column in table D.,		for *app. heat* read *app. height*.
" 329,	line 9th from bottom,		for *sub crenate lime* read *sub crenate of lime*.

I have not corrected the orthography of such words as *traveller*, *crystallized*, &c., since the printers have adopted Webster's Dictionary as their authority, and have uniformly spelled those words with one *l*.


Milton
Farmington
Rochester
Strafford
Blue Hills
Bow P.
Barrington
Northwood
Deerfield
Nottingham
Lee
Durham
Madbury
Dover
Somersworth
Cochecho R.
Salmon Fall R.
Oyster R.
Lamprey R.
Great Bay
Newington
PORTSMOUTH
Epping
Newmarket
Raymond
Greenland
Stratham
Rye
Rye Har.
Ragged Neck
Wallaces Sands
ROCKINGHAM
Poplin
Brentwood
Exeter
Exeter R.
North Hampton
Hampton
Yenness Ledge
Little Boars Head
Great Boars Head
Hampton Har.
Sandown
Danville
Kingston
East Kingston
Kensington
Hampton Falls
Seabrook
South Hampton
Hampstead
Derry
Island P.
Atkinson
Plaistow
Newton
Salem
Note
State Line
County Line
Town Line
Road
Rail Road
Scale 6 Miles to the Inch.
0
6
12
43 15
43
42 45
6 15
6 30

ERRATA.

The reader is requested to correct the pages of this Report with his pen in those places where the typographical or other errors affect the sense of the work.

Page	2,	line	15	from	bottom of page,	for	*geognistic* read *geognostic.*
"	3,	"	11	"	top	"	*flank* read *flank,*
"	7,	"	21	"	bottom	"	*these* read *their.*
"	8,	"	14	"	top	"	*familiar* read *familiar*
"	10,	"	23	"	bottom	"	*chemistry* read *Chemistry.*
"	16,	"	19 & 2[8]		from top	"	*cardoc* read *caradoc.*
"	16,	"	14 & 23		"	"	*landelio* read *landeilo.*
"	16,	"	7		from top	"	*Vanuxen* read *Vanu[illegible]*
"	18,	"	8	"	"	"	*Murchision's* read *Murchison's.*
"	20,	"	10	"	"	"	*dicolyledonous* read *dicotyledonous.*
"	21,	"	11	"	"	"	*callad* read *called.*
"	21,	"	12	"	"	"	*Icthyosaurus* read *Ichthyosaurus.*
"	21,	"	16	"	bottom	"	*petrefied* read *petrified.*
"	24,	"	15	"	bottom	"	*Switzerland* read *Spitzbergen.*
"	38,	"	16	"	top	"	in the formula for *F* read *A.*
"	49,	"	17	"	"	"	*transhipment* read *transshipment.*
"	51,	"	13	"	"	"	*felsparthic* read *felspathic.*
"	54,	"	14	"	bottom	"	*argillaceons* read *argillaceous.*
"	56,	"	4	"	"	"	*flourine* read *fluorine.*
"	56,	"	6	"	"	"	" "
"	62,	"	18	"	top	"	*John Durkee* read *Maj. Topliff.*
"	68,	"	4	"	"	"	*far removed* read *remote.*
"	71,	"	3	"	bottom	"	*ura ursa* read *ura ursi.*
"	80,	"	5	"	"	"	*discoverry* read *discovery.*
"	96,	"	4	"	"	"	*recticulated* read *reticulated.*
"	105,	"	13	"	"	"	*eliptical* read *elliptical.*
"	106,	"	3	"	"	"	*pinacles* read *pinnacles.*
"	109,	"	16	"	top	"	*Erhenberg* read *Ehrenberg.*
"	109,	"	19	"	"	"	*calcaceous* read *calcareous.*
"	109,	"	20	"	"	"	*silicia* read *silica.*
"	115,	"	19	"	"	"	*Ingalls* read *Ruggles.*
"	116,	"	7	"	"	"	*irridescent* read *iridescent.*
"	124,	"	16	"	bottom	"	*calcereous* read *calcareous.*
"	136,	"	12	"	top	"	*silicia* read *silica.*
"	155,	"	11	"	"	"	*Philips* read *Phillips.*
"	188,	"	5	"	"	"	replace the period by a comma, and put *h* for *H* in *having.*
"	190,	"	22	"	"	"	for *effervescence* read *efflorescence.*
"	193,	"	10	"	bottom	"	after *crucible* insert *and the.*
"	194,	"	4	"	"	"	strike out the words, *for transportation.*
"	208,	"	12	"	top	"	for *zinc or blende ore* read *zinc ore or blende.*
"	211,	"	13	"	bottom	"	for *clearly* read *cleanly.*
"	216,	"	22	"	top	"	after locality, for *was* read *were.*
"	216,	"	23	"	"	"	after *This* insert the word *granular.*
"	216,	"	9	"	bottom	"	for *assimilated* read *associated.*
"	217,	"	9	"	top	"	in *cupellings* omit *s.*
"	219,	"	3	"	bottom	"	for *pale* read *full.*
"	220,	"	5	"	top	"	for *Anstel* read *Austel.*
"	222,	"	22	"	bottom	"	for [illegible]*lined* read *an air.*
"	223,	"	21	"	"	"	for *wash tin* read *washed tin.*
"	223,	"	19	"	"	"	for *contains* read *contained.*
"	226,	"	9	"	"	"	for *increase* read *increases.*
"	228,	"	6	"	top	"	after *subsequently*, strike out *be.*
"	229,	"	5	"	"	"	for *ever* read *even.*
"	233,	"	19	"	bottom	"	for *arsenious acids* read *arsenious acid.*
"	235,	"	5	"	top	"	for *smelt* read *smalt.*
"	244,	"	12	"	bottom	"	strike out the word *turnips.*
"	247,	"	17	"	top	"	for *I. I. Berzelius* read *J. J. Berzelius.*
"	254,	"	2	"	"	"	for 17 read 15.
"	254,	"	19	"	bottom	"	for *obtained* read *attained.*
"	255,	"	6	"	top	"	after 16.2 insert *grains of.*
"	257,	"	10	"	bottom	"	for *concoctions* read *concretions.*
"	258,	"	8	"	"	"	for *extinction* read *extrication.*
"	260,	"	23	"	"	"	for *lime* read *zeine.*
"	272,	"	1	at	top	"	for *copper* read *coffee.*
"	282,	"	1	"	"	"	for *Eri* read *Evi.*
"	282,	"	1	"	bottom		

" 316, 1st column in table D., for *app. heat* read *app. height.*
" 329, line 9th from bottom, for *sub crenate lime* read *sub crenate of lime.*

I have not corrected the orthography of such words as *traveller*, *crystallized*, &c., since the printers have adopted Webster's Dictionary as their authority, and have uniformly spelled those words with one *l*.